PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Electronic relays and counters
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Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, ":" e.g. "536.21: 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0: 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page 3 of cover*

MATHEMATICS 51

.3 1141

A simple procedure for the making of alignment charts. ND, W. L. *J. Appl. Phys.*, **19**, 83–6 (*Jan.*, 1948).—plified directions are given for making nomograms m equations in 3 variables. A fixed determinant is d to put the equation in determinantal form. The erminant is manipulated to put it in standard line form; ee standard types of distortion factors are used to duce a chart of convenient shape. A.

.3 : 548.734.52 *see Abstr.* 1363

.5 : 621.317.39 1142

An electronic differential analyzer. KOEHLER, J. S. *Appl. Phys.*, **19**, 148–55 (*Feb.*, 1948).—An electrical ice is designed which will solve ordinary, non-linear, -homogeneous differential equations or the boundary ue problems based on such differential equations. The ice is based on the fact that the charge on the capacitor a series-resonant circuit varies with the time in a nner described by a linear 2nd-order differential ation. The desired variations of the coefficients with e are fed into the apparatus by using a variable voltage erator. This generator provides a small voltage which varies with time in accordance with any given curve. The variable voltage generator has been constructed and operates satisfactorily. The resulting solution is drawn by an oscillograph. The instrument is designed to furnish a solution which does not deviate from the true solution by $> 4\%$. A.

519.2 : 539.155.2 1143

The theory of the study of transfers within a multi-compartment system using isotopic tracers. SHEPPARD, C. W. *J. Appl. Phys.*, **19**, 70–6 (*Jan.*, 1948).—Expressions are derived for a system of n compartments whereby the amount of a substance S which has moved from any one compartment to any other can be determined in a single experiment from measurements of the amounts of n tagged species in the individual compartments. It is shown that n individual species of S are required which must be uniformly mixed and behave identically but must be distinguishable by the observer. The application of the equations to studies using multiple isotopic tracers is described, and the special case of a 2-compartment system is analysed in detail. A.

519.21 : 539.42 *see Abstr.* 1341

ASTRONOMY . ASTROPHYSICS . GEODESY 52

3.322 1144

Brightness of the new moon. VAN LIEMPT, J. A. M. *ture, Lond.*, **161**, 27 (*Jan.* 3, 1948).—Calculations in ways give a value of $\sim 3\times10^{-5}$ stilb.

3.72 : 621.396.822 1145

An investigation of radio-frequency radiation from the n. RYLE, M., AND VONBERG, D. D. *Proc. Roy. Soc. A*, **3**, 98–120 (*April* 22, 1948).—Measurements have been ade of the solar radiation at frequencies of 175 and Mc/s. An apparatus has been developed in which the tput power of a local source of random "noise" is tomatically and continuously adjusted to be equal to e aerial power; in this way the receiver is used only as indicator of balance, and errors due to variation of its in or internal noise are eliminated. A special type of rial has been devised which enables the solar radiation be recorded separately from the galactic radiation, and enables continuous observation of the sun to be made th aerials of comparatively low directivity. The results tained on these two frequencies show that the sun rmally emits radiation whose intensity corresponds to a rface temperature of the order of 10^6 °K. Large ctuations in the intensity occur, however, and during e passage of large sunspots, equivalent temperatures as gh as 10^8 to 10^9 °K have been observed. In addition to ese day-to-day variations the radiation is subject to dden brief increases of intensity lasting only for a few conds. Measurements of the diameter of the source, a method analogous to Michelson's stellar interometer, show that during periods of very great intensity e radiation originates in an area of the sun of the same der of size as a sunspot. This means that equivalent mperatures of 10^9 to 10^{10} °K must exist. Measurements of the polarization of the radiation show that during periods of increased activity the radiation is mainly circularly polarized. A.

523.851.2 = 3 1146

The masses of the globular clusters M 3 and M 13. LOHMANN, W. *Z. Naturforsch.*, **2a**, 477–82 (*Sept.*, 1947) *In German.*—Assuming the luminosity function of Kuiper for the neighbourhood of the sun, the masses are calculated to be 70 000 and 110 000 sun-masses respectively. A.

523.87 1147

Spectrum of white dwarfs. SCHATZMAN, E. *Nature, Lond.*, **161**, 61–2 (*Jan.* 10, 1948).—The absence of metallic lines is likely to be due to the very low concentration in the hydrogen atmosphere of these stars, and not to the Zeeman effect, as suggested by Blackett [Abstr. 1715 (1947)]. Metallic lines may appear in some cases, where the atmosphere is thin and there are strong convection currents.

523.877 : 535.2 : 535.43 1148

The softening of radiation by multiple Compton scattering. CHANDRASEKHAR, S. *Proc. Roy. Soc. A*, **192**, 508–18 (*March* 18, 1948).—The problem of the softening of radiation by multiple Compton scattering in an atmosphere of free electrons is considered. An idealized problem in plane-parallel atmospheres is formulated and the appropriate equation of transfer is approximately solved. The modified distributions with wavelength of the radiation emergent after transmission through various optical thicknesses of an incident monochromatic flux of radiation are tabulated. The calculations show that there is a relatively high probability for quite large shifts even after transmission through optical thicknesses of order unity. A.

PHYSICS 53

FUNDAMENTALS 530.1

0.14 1149

On infinities in generalized meson-field theory. GREEN, E. S. *Phys. Rev.*, **73**, 26–9 (*Jan.* 1, 1948).—The results of an extension of Podolsky's generalized electrodynamics, corresponding to Proca's extension of Maxwellian electrodynamics, are presented. In this extension the Lagrangian is permitted to depend upon the field

co-ordinates themselves, which is a major step in going from electrodynamics to meson-field theory. The static interaction and static self-energy, derived by exact classical and quantum methods, as well as the dynamic interaction and dynamic self-energy, obtained by a quantum-mechanical perturbation method, are given. The complete interaction and self-energy are free from singularities and infinities. This is in contrast with the results of ordinary relativistic meson-field theory. It thus appears that these defects may be removed from meson theory, just as in electrodynamics, by going to a generalized field theory in which the Lagrangian contains the second derivatives of the field co-ordinates. A.

530.14 1150

The gravitational, electromagnetic, and vector meson fields and the similarity geometry. HOFFMANN, B. *Phys. Rev.*, **73**, 30–5 (*Jan.* 1, 1948).—It is shown that a special case of the general conformal geometry, called here the similarity geometry, forms the basis for a unitary theory of the gravitational, electromagnetic, and vector meson fields. The field equations are obtained from a simple 4-dimensional, gauge-invariant variational principle involving the curvature scalar of a basic second rank symmetric similarity tensor $S_{\sigma\tau}$. Since $S_{\sigma\tau}$ is here specialized, there is the possibility of incorporating further fields when the restrictions are removed. A.

530.14 : 539.185 *see Abstr.* 1325

530.145 1151

Note on the Dirac character operators. CORSON, E. M. *Phys. Rev.*, **73**, 57–60 (*Jan.* 1, 1948).—The Dirac character operators are evaluated for the classes of the symmetric group consisting of the triad, double interchange, tetrad, and pentad, and the corresponding group-theoretical primitive characters are listed for comparison. It is also shown that the evaluation of these and similar character operators is all that is required for the solution of the standard molecular problems in the spirit of Dirac's original programme, which avoids appeal to formal group theory. A.

530.145 : 532.7 : 536.7 *see Abstr.* 1235

530.145 : 539.18 : 537.591.15 1152

The multiple production of mesons. LEWIS, H. W., OPPENHEIMER, J. R., AND WOUTHUYSEN, S. A. *Phys. Rev.*, **73**, 127–40 (*Jan.* 15, 1948).—An attempt is made to treat the impacts of nucleons of very high energy ($\gg Mc^2$). These impacts lead to meson emission, despite the relatively small momentum transfers to be expected, because changes of nuclear charge and spin require a readjustment of the nuclear meson fields. Where the fields are strong (as e.g. in the pseudoscalar case), meson emission is multiple, and the multiplicity increases with energy. For weaker coupling (e.g. scalar fields) this is not true. Two closely related methods are developed for a more quantitative description of these collisions. These methods may be expected to give valid results when the collision time is short compared with the periods of the emitted mesons, and when the emission of mesons into the various modes can be treated as statistically independent. Under these conditions the total cross-section may be expected to be $\sim 10^{-26}\,\mathrm{cm}^2$, and the multiplicity to approach for high energies $2g^{\frac{1}{2}}(ME_0/2\pi\mu^2c^2)^{\frac{1}{4}}$, with E_0 the primary energy and g the dimensionless coupling constant. Some applications to the calculation of positive excess, primary spectrum, angular distribution, and the theory of Auger showers, are discussed briefly in the final section. A.

530.162 : 535.23 *see Abstr.* 1191

530.162 : 591.185 *see Abstr.* 1373

530.162 : 621.38 : 537.533 : 537.3 *see Abstr.* 1239–40

GENERAL MECHANICS
MECHANICS OF SOLIDS 531

531.222 : 539.37.08 11

A new device for maintaining constant stress in a r undergoing plastic extension. ANDRADE, E. N. DA *Proc. Phys. Soc., Lond.*, **60**, 304–7 (*March*, 1948).— simple mechanism of hinged rods is described. The mi point of the wire maintains its position during extensio enabling observation by a fixed microscope.

531.224.4 11

Instability of simply supported square plate with r inforced circular hole in edge compression. LEVY, S WOOLLEY, R. M., AND KROLL, W. D. *J. Res. Nat. Bu Stand., Wash.*, **39**, 571–7 (*Dec.*, 1947).—A method presented for computing the compressive buckling lo of a simply supported elastic rectangular plate having central circular hole reinforced by a circular doubler pla Numerical results are presented for six square plat having hole diameters up to $\frac{1}{2}$ the plate length. Cor parison of these results with those computed for plat without holes shows that an unreinforced circular ho causes a relatively small reduction in buckling load, a reinforcement of a circular hole by a doubler plate caus a substantial increase in buckling load.

531.258 11

On the stresses in a plate containing two circular hol LING, C. B. *J. Appl. Phys.*, **19**, 77–81 (*Jan.*, 194 —The method of solution is to add to the given stre system a suitable biharmonic function which gives r stress at ∞. The parametric coefficients involved in t solution are adjusted so as to satisfy the bounda conditions at the edges of the (equal) holes. Thr fundamental stress systems are discussed in some deta namely, the all-around tension case, the longitudin tension case, and the transverse tension case. Formul of the stress along the edges of holes are derived and, particular, values of maximum stress are calculated. T limiting case in which the holes are tangential is al discussed.

531.259.2 : 539.374 *see Abstr.* 1339

531.38.082.5 : 535.32 : 535.417 *see Abstr.* 1216

MECHANICAL MEASUREMENTS 531.7

531.711 : 535.33 *see Abstr.* 1194

531.752 : 538.082.1 : 536.581.3 *see Abstr.* 1231

531.768 11

A new type of servo-accelerometer and aircraft di angle indicator. JACOBS, D. H. *Rev. Sci. Instrum.*, 1 118–19 (*Feb.*, 1948).—A weighted, pivoted arm, lyi between two electrical contacts, is maintained in positio under the opposing forces of inertia and of a spring, t amount of the latter being controlled by a motor actuat by the contacts, and giving a measure of the acceleratio A compact and accurate design is briefly described a illustrated.

531.775 : 621.317.39 11

A supersensitive tachometer. BROWN, E. B. *J. Sc Instrum. Phys. Ind.*, **25**, 47–8 (*Feb.*, 1948).—[Abstr. 1161 (1948)].

531.781 : 621.9.014.2 : 621.317.39 = 4 11

Electromagnetic dynamometer for recording instan taneous variations in cutting force. RUDOLPH, M. *Re Gen. Élect.*, **57**, 24–6 (*Jan.*, 1948) *In French.*—[Abst 1164 B (1948)].

MECHANICS OF LIQUIDS 532

.516 : 541.183 : 539.62 *see Abstr.* 1344

.517.2 1159

The laminar boundary-layer equations. I. Motion of an ptic and circular cylinders. MEKSYN, D. *Proc. Roy. . A*, **192**, 545–67 (*March* 18, 1948).

.517.2 1160

The laminar boundary-layer equations. II. Integration non-linear ordinary differential equations. MEKSYN, D. *oc. Roy. Soc. A*, **192**, 567–75 (*March* 18, 1948).

.525 : 536.423 1161

High velocity vaporizers. COMINGS, E. W., ADAMS, H., AND SHIPPEE, E. D. *Industr. Engng Chem.*, **40**, -6 (*Jan.*, 1948).—A method of vaporizing relatively h boiling or thermally unstable liquids into a hot gas eam is described. The liquid under low pressure is roduced as a simple jet into a high velocity hot gas eam. The liquid is thus atomized to drops $< 100\ \mu$ in ameter, and high rates of heat transfer to the liquid and porization of the liquid are obtained. A Venturi tube a useful design for obtaining the high velocity. The t gas is cooled rapidly, and the time of exposure of the uid to a high temperature is very short, of the order of ew millisec. A.

.525 : 541.182.2 1162

Atomization of liquids in high velocity gas streams. WIS, H. C., EDWARDS, D. G., GOGLIA, M. J., RICE, I., AND SMITH, L. W. *Industr. Engng Chem.*, **40**, 67–74 *m.*, 1948).—Attention is called to the general useful-ss, for purposes of design and control, of the empirical uations recently published by Nukiyama and Tanasawa. e mathematics of the equations is discussed, and it is own that drop size distribution data can be expressed terms of a simple straight-line relation. In the case of s-atomizing nozzles, analysis of the data in the litera-re reveals substantial agreement with the equations. the case of liquid spray nozzles the agreement of the uations is more qualitative. Experiments on gas-omizing nozzles are described. These corroborate and tend the work of Nukiyama and Tanasawa and give an dication of the effects of gas density, gas viscosity, heat nsfer from gas to liquid, and the scale of the apparatus the performance of gas-atomizing nozzles. A.

.527 : 534.231 *see Abstr.* 1180

.528 : 551.54 1163

Influence of atmospheric pressure on the phenomena companying the entry of spheres into water. GILBARG, ., AND ANDERSON, R. A. *J. Appl. Phys.*, **19**, 127–39 *eb.*, 1948).—High speed motion-picture studies were ade of the dependence of air-water entry cavities on the levant physical parameters—in particular, on the mospheric pressure over the water surface. Experi-ents on the vertical entry of spheres $\frac{1}{4}$ in to 1 in in ameter, with entrance velocities between 15 and 0 ft/sec, and air pressures between 1/60 and 3 atmos., ow that surface sealing of the cavity is a major factor controlling cavity formation, and is the factor most sponsible for non-Froude scaling of cavity phenomena. rface sealing is a function chiefly of the atmospheric nsity and projectile velocity, although surface tension also important in its effect on splash formation. roude's scaling is found to hold true in the region of w Froude's numbers and low atmospheric pressures. he measured average drag coefficient of the projectiles independent of cavity size and shape. Jets are found to cur regularly and with great strength at both deep and rface closures of the cavity. The observed presence of jets in finite cavities is predicted by an extension of the Kirchhoff–Helmholtz theory of the infinite (2-dimensional) cavity to the case of finite cavities with finite cavitation numbers. Some of the results of this theory are mentioned. A.

CAPILLARITY 532.6

532.612.4 1164

Surface tension of compositions in the systems PbO–B_2O_3 and PbO–SiO_2. SHARTSIS, L., SPINNER, S., AND SMOCK, A. W. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 61–6 (*Jan.*, 1948).

532.612.4 : 541.183 1165

Time-dependence of surface tension of solutions. BLAIR, C. M., JR. *J. Chem. Phys.*, **16**, 113–15 (*Feb.*, 1948).—The slow rate of change of surface tension observed by Addison [Abstr. 2798 (1945)] with aqueous solutions of fatty alcohols cannot be explained by diffusion alone. It is assumed that the adsorption of non-electrolyte solutes in the surface film is opposed by a constant potential energy barrier, and, on this basis, a relation between spreading pressure and surface age is developed. With the resulting equation, the experimental data of Addison are employed to evaluate the energy term. Nearly constant values for the assumed barrier are obtained, the actual calculated values, in calories per mole at 20°C, being about 1 900 for isoamyl alcohol, 1 300 for *n*-hexyl alcohol, and 700 for *n*-heptyl alcohol. A second relation between spreading pressure and surface age is derived on the assumption that the energy barrier is a linear function of spreading pressure. The use of Addison's data for isoamyl alcohol in this relation indicates that the spreading-pressure-dependent portion of the barrier is small and of the same order of magnitude as the energy required to compress the surface film sufficiently to admit the entering solute molecule. A.

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 530.145 : 536.7 *see Abstr.* 1235

532.74 : 534.321.9 : 534.22.096 *see Abstr.* 1179

532.74 : 536.22 *see Abstr.* 1223

532.772 : 539.16 1166

The use of tritium in the determination of the solubility of water in solvents. The solubility of water in benzene. JORIS, G. G., AND TAYLOR, H. S. *J. Chem. Phys.*, **16**, 45–51 (*Jan.*, 1948).—A new method for determination of the solubility of water in hydrocarbons is based on the use of radioactive H isotope, H^3, as tracer for the dissolved water. This method is applicable to the determination of the solubility of water in compounds in which it is sparingly soluble. A.

532.782 : 548.73 *see Abstr.* 1360

MECHANICS OF GASES 533

533.15 : 539.155.2 1167

The effect of certain column variables on thermal diffusion. DRICKAMER, H. G., O'BRIEN, V. J., BRESEE, J. C., AND OCKERT, C. E. *J. Chem. Phys.*, **16**, 122–7 (*Feb.*, 1948).—Tests have been made on two thermal diffusion columns with different annular spacing. The results indicate that the dependence of the separation on temperature and annular spacing predicted by Furry, Jones, and Onsager [Abstr. 2666 (1939)] holds. The dependence on pressure is slightly different from that

predicted. The possibility that the index of repulsive force may depend on the pressure is pointed out. A.

533.15 : 541.183 : 539.217.1 1168

The flow of gases and vapors through adsorbing porous media. TOMLINSON, R. H., AND FLOOD, E. A. *Canad. J. Res. B*, **26**, 38–53 (*Jan.*, 1948).—The flow rates of gases and vapours through highly activated charcoal rods have been measured. The results obtained indicate that a new phenomenon has been discovered. While the flow rates of gases that are not highly adsorbed can be satisfactorily correlated by the Adzumi and other similar equations, the strongly adsorbed vapours of diethyl ether and ethyl chloride pass through at rates considerably > those required by known equations. It appears necessary to resort to mechanisms quite outside those usually considered in the application of kinetic theory to problems associated with passage of gas through porous diaphragms. The simplest and most direct of such mechanisms involves mobility of the adsorbed material. The flow rate of diethyl ether through activated charcoal rods has been found to be > that of He in pressure regions where relative rates of flow of gases through non-adsorbing porous diaphragms are dominated by inverse square root molecular weight ratios. The measurement of gaseous flow rates through porous media is rendered the more difficult where appreciable adsorption occurs. The experimental methods are described in detail, sources of error are discussed, and results presented for He, H_2, N_2, CO_2, diethyl ether, and ethyl chloride. A.

533.16 : 536.23 *see Abstr.* 1225

533.275 : 536.423.15 1169

The control of humidity by saturated salt solutions. O'BRIEN, F. E. M. *J. Sci. Instrum. Phys. Ind.*, **25**, 73–6 (*March*, 1948).—A table of data gives % relative humidities over saturated solutions of 88 different salts or salt mixtures. Remarks on the suitability of these solutions for humidity control are included. A.

533.275 : 536.423.45 1170

An automatic dewpoint meter for the determination of condensable vapors. PUCK, T. T. *Rev. Sci. Instrum.*, **19**, 16–23 (*Jan.*, 1948).—A method for very small concentrations by measurement of the decrease in reflectivity of a cooled surface is described. The method is applicable to mixtures of 2 components, one of which may be water. Use is made of the fact that a vapour will condense at a concentration below its vapour pressure in the presence of a second vapour whose liquid is soluble in that of the first. The most volatile component of the mixture is used in the pure state as a refrigerating agent whose evaporation cools the light-reflecting surface to an accurately regulated temperature which produces condensation of the two components. An instrument embodying these principles is described which quantitatively measures triethylene glycol in concentrations as low as 10^{-4} mm Hg. The construction is simple and the operation continuous and automatic. By proper adjustment, automatic compensation for changing atmospheric relative humidity can be secured so as to obtain response only to the degree of saturation of the vapour in air. A.

533.43 1171

A study of anaeroid capsules. PIKE, E. W., AND GIBBS, N. E. *J. Appl. Phys.*, **19**, 106–8 (*Jan.*, 1948).—The analysis of aneroid capsule performance by the expansion of the observed pressure-deflection curve in Gram summation-orthogonal polynomials is illustrated on a series of typical capsules. All of the deflection curves examined contained significant cubic and quartic terms while a few showed 5th-order terms. These are very unstable in magnitude and sign for successive deflectio of the same capsule, and this accounts for the ve complex hysteresis curves which have been observe The relationship of these terms to the accuracy and co of precise aneroid barometers is brought out, and it suggested that barometric systems free of elastic r dundancies must be devised if accurate barometers f radiosondes and similar instruments are to be ma produced.

533.5 : 621.314.5 = 3 11

Vacuum problems in rectifier practice. SCHULZE, V *Elektrotech. u. Maschinenb.* [*EuM*] **61**, 593–601 (*Dec.* 1 1943) *In German.*—[Abstr. 1109 B (1948)].

533.5 : 621.521 11

Vacuum pumping equipment and systems. SULLIVA H. M. *Rev. Sci. Instrum.*, **19**, 1–15 (*Jan.*, 1948).— Typical rotary mechanical pumps, booster pumps, an diffusion pumps available today are described. Funda mental operating principles are discussed. The metho for making theoretical computations of the conductan and speed of evacuation of a vacuum system is outline

533.59 11

High vacuum valve and seal. KING, L. D. P. *Rev. Sc Instrum.*, **19**, 83–4 (*Feb.*, 1948).—A simple two-way valv and a method of making a seal are described, both we adapted to large or small port openings in high vacuu work. The valve gate consists of two rigid flat surfac on which are mounted the gaskets. The plates a normally drawn together but can be pushed in front o the ports and forced apart by the action of a cam fixe to a rod. A round rubber gasket held in a special groov of one surface pushed against another flat surface pr duces an excellent vacuum seal. The metal-to-metal sea prevents injury to the rubber from excessive pressure c the exposure of the rubber to the vacuum system.

533.6.011.6 : 534.222.2 11

Gas dynamic treatment of exothermic and endotherm discontinuities. SAMARAS, D. G. *Canad. J. Res. A*, 2 1–21 (*Jan.*, 1948).—Endothermic and exothermic pr cesses in gas dynamic flows taking place in a very narro zone may be considered as discontinuities. The variatio of the static and total head density ratio, pressure rati and temperature ratio as well as the angle of deviatio area ratio, and exit normal Mach number have bee found as functions of the entry normal Mach numb and of heat addition. In addition to these, some oth useful quantities such as the area ratio parameter, th difference of the square of velocities, and the norm velocity product have been evaluated. It was found tha in a discontinuity, heat can be added until the ex normal Mach number reaches unity (choking). Depen ing on the entry normal Mach number, only a limite amount of heat can be added at the discontinuity. A exothermic discontinuity behaves as an expansion whe the entry normal Mach number is subsonic, and it accompanied by a drop in static pressure, density, an total head pressure. An exothermic discontinuit behaves as a compression shock wave when the entr normal Mach number is supersonic, and it is accom panied by an increase in static pressure and density an a decrease in total head pressure. An endotherm discontinuity behaves always as a compression sho wave, and it is accompanied by an increase in stati density, pressure, and total head pressure. The result and conclusions may be useful in understanding man nearly discontinuous phenomena such as flame front condensation and evaporation fronts.

KINETIC THEORY OF GASES 533.7

.7 : 536.23 *see Abstr.* 1226

.7 : 536.7 : 534.22 *see Abstr.* 1178

.7 : 539.13 *see Abstr.* 1286

.75 : 536.71 : 541.126 1176

An equation of state for gases at extremely high ssures and temperatures from the hydrodynamic theory detonation. PATERSON, S. *J. Chem. Phys.*, **16,** 159 *b.*, 1948).—Errors in Cook's work [Abstr. 2798 47)] are pointed out which invalidate his demonstran that α is independent of T.

VIBRATIONS . ACOUSTICS 534

.13 1177

An integral-equation approach to problems of vibrating ms. I–II. WHITE, W. T. *J. Franklin Inst.*, **245,** 25–36 *n*); 117–34 (*Feb.*, 1948).—Integral equations are plied for the calculation of the normal modes. Both ict and approximate methods of solving the integral iation are considered. The Green's function, or nel, of the integral equation is constructed for both iform and non-uniform beams. Solutions for the rmal modes of a uniform cantilever are given. A nonniform, naturally-twisted turbine blade is studied in tail, and the first and second normal modes are culated. A.

.213.4 : 621.392 : 537.212 *see Abstr.* 1237

.213.4 : 621.396.9 : 534.321.9 *see Abstr.* 1182–4

.22 : 533.7 : 536.7 1178

The velocity of sound in gaseous helium in connection th the virial coefficients. WALSTRA, W. K. *Commun. ppl. K. Onnes Lab. Leiden* (*No. 95b*). *Physica, 's av.*, **13,** 643–52 (*Dec.*, 1947).—The velocity of sound s been calculated for the regions of temperatures and essures where the second and third virial coefficients known; the results agree with experimental values thin ½% at liquid He temps., and within 1% at liquid temps. A.

.22 : 536.22 : 536.48 *see Abstr.* 1230

.22.096 : 534.321.9 : 532.74 1179

Supersonics in a water-alcohol mixture and analysis of intermolecular action. PARSHAD, R. *J. Acoust. Soc. ner.*, **20,** 66–7 (*Jan.*, 1948).—An explanation of iacomini's observations [Abstr. 264 (1948)] is offered the basis of the author's theories and measurements bstr. 1018 (1946), 2802 (1947)].

.222.2 : 533.6.011.6 *see Abstr.* 1175

.231 : 532.527 1180

Vortices and streams caused by sound waves. ECKART, *Phys. Rev.*, **73,** 68–76 (*Jan.* 1, 1948).—The general uations of second-order acoustic phenomena depending the viscosity of the medium are developed. The rtia of acoustic energy, radiation pressure and variable mpressibility of the medium, all produce overtones hich may be quite large. The viscous forces cause the neration of vortices, which ultimately approach a eady state. Calculations of the velocity of the stream nerated by a beam of sound show that it $\propto$ (1) $= (4/3) + (\nu'/\nu)$, where ν and ν' = bulk and shear scosities, (2) power radiated in the beam, (3) (wavength)$^{-2}$, (4) $\rho^{-2}c^{-3}$, where ρ = density, c = sound locity in the medium. The max. value of the steadyreaming velocity depends on the resistance of the perimental vessel or room; the time required to set up the steady state $\propto$ 1/(this resistance), and the flow may become turbulent if the resistance is low. A.

534.232 1181

On the radiation of sound from an unflanged circular pipe. LEVINE, H., AND SCHWINGER, J. *Phys. Rev.*, **73,** 383–406 (*Feb.* 15, 1948).—A rigorous and explicit solution is obtained for the problem of sound radiation from an unflanged circular pipe, assuming axially symmetric excitation. The solution is valid throughout the wavelength range of dominant mode (plane wave) propagation in the pipe. The reflection coefficient for the velocity potential within the pipe and the power-gain function, embodying the characteristics of the radiation pattern, are evaluated numerically. The absorption cross-section of the pipe for a plane wave incident from external space, and the gain function for this direction, are found to satisfy a reciprocity relation. In particular, the absorption cross-section for normal incidence = the area of the mouth. At low frequencies of vibration, the velocity potential within the pipe is the same as if the pipe were lengthened by a certain fraction of the radius and the open end behaved as a loop. The exact value of the end correction turns out to be 0·6133. A.

534.321.9 : 532.74 : 534.22.096 *see Abstr.* 1179

534.321.9 : 534.213.4 : 621.396.9 1182

Ultrasonic delay lines. I. HUNTINGTON, H. B., EMSLIE, A. G., AND HUGHES, V. W. *J. Franklin Inst.*, **245,** 1–24 (*Jan.*, 1948).—This paper is concerned mainly with the theoretical considerations involved in the general process of ultrasonic propagation. The transducer action is given considerable attention and an equivalent circuit employing a transmission line as an element is demonstrated. The diffraction spreading of the beam and absorptive losses in the transmitting medium are also discussed. A.

534.321.9 : 534.213.4 : 621.396.9 1183

Ultrasonic delay lines. II. EMSLIE, A. G., HUNTINGTON, H. B., SHAPIRO, H., AND BENFIELD, A. E. *J. Franklin Inst.*, **245,** 101–16 (*Feb.*, 1948).—This paper deals with the experimental aspects of ultrasonic delay lines in liquid media. Delay devices employing ultrasonic propagation through liquids have proved satisfactory for delay times of the order of 3 msec or less. Such devices can be made broadband and give excellent reproduction of pulse shape. The design considerations for such devices are discussed and illustrated by actual examples. A.

534.321.9 : 534.213.4 : 621.396.9 1184

Ultrasonic solid delay lines. ARENBERG, D. L. *J. Acoust. Soc. Amer.*, **20,** 1–26 (*Jan.*, 1948).—The development of an ultrasonic delay line for the storage of pulses 1 μsec long for periods up to 2 000 μsec is discussed. (Bibliography of 30 refs.) Theoretical considerations of the piezoelectric transducer involving the quartz crystals and acoustical constants of the medium [Abstr. 1182 (1948)] are applied to determine the band-width and power loss of the delay line. Problems, peculiar to the use of solids because of the presence of more than one mode of propagation and the distribution of energy between the different modes on reflection from an air surface, are evaluated for a wide range of Poisson ratios. Measurements of velocity and attenuation in some polycrystalline metals, single crystals, and glasses are given. Fused quartz was found to be the most promising material. Delay lines constructed using a light source and photoelastic pick-up were not completely developed, but several types using crystal pick-up as well as transmitter were satisfactory. For delay times $>$ 300 μsec, multiple reflection paths in 2 and 3 dimensions were used, and their preparation from fused quartz is discussed. A.

534.6 1185

A mobile laboratory for acoustical work. COPELAND, W. C. *J. Sci. Instrum. Phys. Ind.*, **25**, 82–5 (*March*, 1948).

534.6 : 539.217.1 1186

Simplified porosity measurements. LEONARD, R. W. *J. Acoust. Soc. Amer.*, **20**, 39–41 (*Jan.*, 1948).—The essential feature of the dynamic method described here is the use of the compliance of the air in the pores of the material to control the period of the free damped oscillation of a mechanical system. The dynamic method has the advantage of small temperature-dependence and minimum time for a single measurement. A.

534.75 : 612.85 1187

Monaural and binaural threshold sensitivity for tones and for white noise. POLLACK, I. *J. Acoust. Soc. Amer.*, **20**, 52–7 (*Jan.*, 1948).—For 10 subjects, the binaural threshold was found to be significantly < the monaural when ear sensitivity differences were compensated by giving the worse ear an appropriately louder signal. The difference between the binaural threshold and that of the better ear alone diminished as the difference between the stimulation of the two ears was increased. These results are not consistent with the theory that the threshold is the sum of the effective acoustic powers at the two ears. A.

534.75 : 612.85 1188

The effect of noise in one ear upon the loudness of speech in the other ear. EGAN, J. P. *J. Acoust. Soc. Amer.*, **20**, 58–62 (*Jan.*, 1948).—Although an intense noise in one ear will mask speech heard in the other, a weaker noise enhances the loudness of the speech. Experiments on this phenomenon are reported, and the results discussed. The enhanced loudness appears to decline only slowly when the noise is removed (2–4 sec), indicating some muscular adaptation of the ear. Alternatively, the effect is due to an inability to distinguish effectively between the two components. A.

534.75 : 621.395.8 1189

Effects of differentiation, integration, and infinite peak clipping upon the intelligibility of speech. LICKLIDER, J. C. R., AND POLLACK, I. *J. Acoust. Soc. Amer.*, **20**, 42–51 (*Jan.*, 1948).—Intelligibility has been found to be surprisingly little affected by peak clipping, even to the extent of "infinite" clipping, resulting in rectangular pulses. The present paper reports experiments on the combination of various frequency-dependent transmission circuits with infinite peak clipping; they are found capable of exerting a considerable effect, depending on whether they are inserted before or after the clipping circuits. E.g. the sequence "integration, clipping, differentiation" gave only 15% intelligibility; the reverse sequence, 97%. A.

534.773 1190

Cavity pressure method for measuring the gain of hearing aids. CORLISS, E. L. R., AND COOK, G. S. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 85–91 (*Jan.*, 1948).—A method has been developed which has the advantage of requiring no "dead" room, allowing a compact set-up. The method has been investigated as to its validity and the degree to which diffraction effects are avoided. Comparisons with free-field data are made. The applicability of results obtained by this method to the specification of gain characteristics for hearing aids is discussed. A.

OPTICS . RADIATION . SPECTRA 535

535.2 : 535.43 : 523.877 *see Abstr.* 1148

535.215.2 : 537.311.33 : 537.533 *see Abstr.* 1254

535.23 : 530.162 11

A note on thermal fluctuation. KOTHARI, D. AND KOTHARI, L. S. *Indian J. Phys.*, **21**, 307– (*Dec.*, 1947).—The problem of fluctuation of ener in a stream of radiation and particles is treated the basis of the general distribution law, for Bos Einstein and Fermi–Dirac statistics. Section 1 mentio the distribution law and gives values of several consta for the extreme relativistic and non-relativistic cases. section 2 is discussed the energy fluctuation in a fix volume. The expressions for the fluctuations in ener in a beam crossing an area are derived in the next sectic The last section deals with the entropy of a beam. It noted therein that the entropy is finite for a beam of ze intensity and also that a beam of finite intensity but ze entropy is possible.

535.31 : 535.8 11

On perfect optical instruments. SMITH, T. *Proc. Phy Soc., Lond.*, **60**, 292–304 (*March*, 1948).—The angul characteristic function T is used to investigate optic systems of finite focal length in which one extend surface is imaged on another without aberration. T forms of T found earlier to correspond to perfect image are shown to be exhaustive. When perfect imagery achieved the image surface is similar to the object surfac with the exception that it may be stretched uniformly arbitrary amounts in each of three mutually perpendicul directions. The length of the optical path betwe conjugate points of these surfaces is proportional to t distance of either from a fixed plane. In general only o object surface can be imaged without aberration. In exceptional group two pairs of conjugate surfaces—par of centred 2nd-order surfaces—can be perfectly image The two surfaces of the same space have coincide principal axes, and in each of these directions the produ of the two magnifications is equal to the square of t ratio of the refractive indices of the external media. general the centre of the object is not perfectly image The length of the path from any point of either obje surface to its image is invariable. The only elementa example of this group is a single spherical refracti surface. Another exceptional case is when the conjuga surfaces are plane. It is shown that in addition to bei free from all aberrations for a single magnification system such as a photographic lens can produce imag free from curvature, astigmatism and distortion for a magnifications. The properties found for both the groups contradict some general conclusions reached b Clerk Maxwell. Though the existence of perfect instr ments is not inconsistent with optical laws, materi systems of reflecting or refracting surfaces, whatever the shapes, do not enable this ultimate standard to be ful realised. This shortcoming bears significantly on t methods used in designing optical instruments.

535.312 : 621.396.11 : 538.56 *see Abstr.* 1282

535.317 119

Algebraic theory of the primary aberrations of t symmetrical optical system. BUCHDAHL, H. A. *J. Op Soc. Amer.*, **38**, 14–19 (*Jan.*, 1948).—A concise, purel algebraic theory of the monochromatic primary aberr tions of the symmetrical optical system is developed b means of a method depending on the consideration c quantities which reduce to optical invariants in th paraxial limit. The derivation of summation theorems rendered superfluous. At every stage the order of th errors committed in the various approximations involve is considered in detail, with a corresponding gain i rigour. The equations for the final aberrations ar derived in a well-known form. They contain aberratio

fficients closely resembling the usual Seidel sums, and ucing to the latter when all the refracting surfaces are erical. The increase in the labour involved in comput- these more general sums is very small. A.

5.317 : 535.42 *see Abstr.* 1217

5.32 : 531.38.082.5 : 535.417 *see Abstr.* 1216

5.32 : 548.0 *see Abstr.* 1358

5.33 : 531.711 1194

A light wave of artificial mercury as the ultimate ndard of length. MEGGERS, W. F. *J. Opt. Soc. ner.*, **38**, 7–14 (*Jan.*, 1948).—The history of light-wave ndards is briefly reviewed. The recent manufacture of ^{198} by neutron-bombardment of Au in a pile enables specially sharp lines of the Hg spectrum to be used hout the complication of hyperfine structure. The st suitable design of lamps is discussed. Preliminary asurements of wavelengths have been made relative to primary standard with an accuracy 100× that attain- le with natural Hg.

5.33 : 537.531 *see Abstr.* 1253

5.33 : 545.82 *see Abstr.* 1357

5.33.03 : 545.82 1195

An improved spectrographic source. BRAUDO, C., AND LAYTON, H. R. *J. Soc. Chem. Ind.*, **66**, 259–67 (*Aug.*, 47).—The requirements for a spectrographic source of able characteristics are discussed and a circuit is then scribed which fulfils these conditions. The circuit has en tested by analysing numerous samples of a strong oy, and of pure Al, and the standard deviations of the sults indicate that it is a substantial improvement over e condensed spark source normally employed. A brief scussion of the processes in the analytical gap as they fect choice of circuit conditions, and of the considera- ns involved in the selection of spectrum line pairs for e in analytical spectrography concludes the paper. A.

5.33.03–31 1196

A source of continuous spectrum in the ultra-violet. AMASASTRY, C. *Indian J. Phys.*, **21**, 272–4 (*Dec.*, 1947). An h.f. discharge through I_2 vapour is described as a mple source of continuous spectrum in the region 000–λ1950. A.

5.33.072 1197

Calibrated null circuit for Perkin–Elmer infra-red ectrometer. CHAPMAN, R. L., COLTHUP, N. B., AND RANCEL, R. J. *Rev. Sci. Instrum.*, **19**, 116–17 (*Feb.*, 948).

35.33.072 : 545.82 1198

The automatic control of the spectrographic exposure. ENTRY, C. H. R., NEWSON, D., AND RUSHMAN, D. F. *Soc. Chem. Ind.*, **66**, 323–5 (*Sept.*, 1947).—An electronic rcuit is described by which the following cycle of perations automatically occurs on initiation: the pre- ark starts, the spectrograph shutter opens after a fixed me, the plate remains exposed for the required period, en the shutter closes just prior to switching off the spark nd finally the apparatus is reset. By choosing suitable alues of the components, a multiposition selector switch nables a choice of pre-spark and the exposure times to e made. It is claimed that this device eliminates some f the tedium of routine spectrograph analysis, saves the perator's time and eliminates some of the personal rror. A.

35.331 : 539.153.4 *see Abstr.* 1303

35.338.4 1199

The band spectrum of cadmium chloride. RAMASASTRY, . *Indian J. Phys.*, **21**, 267–71 (*Dec.*, 1947).—The spectrum of CdCl excited by a h.f. oscillator was investigated from the red down to λ1850. The Cornell system between λλ2240–2181 has been extended, altogether 19 bands being recorded. These are arranged into four v' progressions which enabled the determination of the vibrational constant chiefly of the upper state: $\nu_e = 45\,398{\cdot}2$, $\omega' = 264{\cdot}0$, $\omega'' = 330{\cdot}9$, $\chi'\omega' = 7{\cdot}5$, $\chi''\omega'' = 1{\cdot}0$. The peculiar appearance of the bands is interpreted as due to the predissociation in the upper state at some high rotational level of $v' = 2$. There is no evidence, in emission, of the bands recorded by Walter and Barratt [Abstr. 1565 (1929)] in absorption in the region λλ3181–3018. A new emission system was observed in the visible region consisting of 23 red-degraded bands from 4 800 Å–4 000 Å; some of these bands indicated a rotational structure even under small dispersion. A.

535.341 1200

The measurement of strongly reflecting transmission samples with the commercial recording spectrophotometer. MIDDLETON, W. E. K. *J. Opt. Soc. Amer.*, **38**, 74–5 (*Jan.*, 1948).—Measurements with this photometer [Abstr. 4965 (1938)] show very large errors if any light is reflected from the sample on to the decentred lenses of the photometer. A remedy is suggested. [See also Abstr. 2657 (1940)].

535.343 : 539.132 *see Abstr.* 1291–2

535.343–15 : 535.375.5 1201

Erratum: Infra-red spectrum and depolarization factors of the Raman lines of spiropentane and the Raman and infra-red spectra of 1,1-dimethylcyclopropane, 1-methyl-cyclobutene, and methylenecyclobutane. CLEVELAND, F. F., MURRAY, M. J., AND GALLAWAY, W. S. *J. Chem. Phys.*, **16**, 158 (*Feb.*, 1948).—See Abstr. 291 (1948).

535.343–15 : 535.51–15 : 539.13 : 548.75 1202

Infra-red spectra and the solid state: measurements with polarized radiation. MANN, J., AND THOMPSON, H. W. *Proc. Roy. Soc. A*, **192**, 489–97 (*March* 18, 1948).—The absorption spectra of some crystalline and oriented solids have been measured using plane-polarized infra-red radiation. The sample was examined successively with the direction of orientation of the crystals || or ⊥ to the direction of vibration of the electric vector in the polarized incident beam. Differences in relative intensity of the absorption bands have been found with many substances as the sample is rotated. These changes are particularly marked with vibration bands of polar linkages such as C=O, N—H or O—H, and in such cases where a particular absorption band can be assigned to some link or group it may be possible from measurements on the variation of intensities to determine the geometrical structure within the molecule. The method therefore promises to be a supplement to crystal analysis, or alternatively, if the molecular and crystal structure is known, to help in the assignment of molecular vibration frequencies. A.

535.343–15 : 539.132 *see Abstr.* 1293

535.343.2 : 537.531 : 539.11 *see Abstr.* 1284

535.343.2–14 : 538.222 *see Abstr.* 1274

535.343.4–14 : 539.132 *see Abstr.* 1294

535.343.4–14 : 539.152.2 : 539.132 *see Abstr.* 1296

535.343.4–15 : 539.133 1203

Rotation-vibration spectra of diatomic and simple poly-atomic molecules with long absorbing paths. I. The spectrum of fluoroform (CHF_3) from 2·4 μ to 0·7 μ. BERNSTEIN, H. J., AND HERZBERG, G. *J. Chem. Phys.*, **16**, 30–9 (*Jan.*, 1948).—The spectrum of fluoroform has been investigated under high resolution (21-ft grating) in

the photographic infra-red with an absorbing path of up to 60 m, obtained by multiple reflection. In addition, with the same path length, the spectrum from 1·2 to 2·4 μ was obtained under low resolution with a photoelectric infra-red spectrometer. A large number of overtone and combination bands, 47 in all, was found. Two parallel bands in the photographic region were well resolved and analysed, yielding, for the moment of inertia about an axis perpendicular to the symmetry axis, $I_B^{[0]} = 81{\cdot}08 \times 10^{-40}$ g cm². From this value, assuming tetrahedral angles and a C–H distance as in methane, the C–F distance in fluoroform is found to be 1·329 Å, a value that is appreciably lower than that found in methyl fluoride, 1·380 Å. A provisional vibrational assignment of all the bands is given. A.

535.343.4–15 : 539.133 1204

The infra-red absorption spectrum of hexafluoroethane gas. NIELSEN, J. R., RICHARDS, C. M., AND MCMURRY, H. L. *J. Chem. Phys.*, **16**, 67–73 (*Jan.*, 1948).—The absorption has been investigated between 2 and 25 μ with prism spectrometers of high resolution. On the basis of normal vibration calculations and the known Raman frequencies it has been possible to interpret all but 3 of the 51 observed absorption maxima. Only combination bands permitted for both the staggered (D_{3d}) and the eclipsed (D_{3h}) model were used in the assignment of bands. Five fundamental frequencies have been determined in addition to the six obtained from the Raman spectrum. No combination band involving the remaining frequency, associated with the torsional oscillation of one CF_3 group relative to the other, could be identified. An attempt to determine the moments of inertia of the C_2F_6 molecule from the envelope of the strongest parallel band gave unsatisfactory results. [See Abstr. 1287 (1948)]. A.

535.343.4–31 1205

Band spectrum of carbon disulphide. I. Triatomic molecule, CS_2. RAMASASTRY, C., AND RAO, K. R. *Indian J. Phys.*, **21**, 313–21 (*Dec.*, 1947).—The absorption bands of CS_2 vapour were photographed under different conditions of pressure and temperature in the ultra-violet. The behaviour of the characteristic bands of the CS_2 molecule between $\lambda\lambda$2300–1940 has been examined and wavelength data of this system are presented in detail. Two prominent progressions are detected among the bands, only one of which was reported previously [Abstr. 2041 (1938)]. While this progression can be represented as the transition $(v, 0, 0)' \leftarrow (0, 0, 0)''$, the new progression is interpreted as corresponding to $(v, 2, 0)' \leftarrow (0, 0, 0)''$. This leads to the suggestion of a value of 235 cm^{-1} for the deformation frequency of the upper electronic state of the molecule, which has a value of 400 cm^{-1} for the corresponding frequency in the ground state. A.

535.343.4–31 1206

Search for near ultraviolet bands in borazole. JACOBS, L. E., PLATT, J. R., AND SCHAEFFER, G. W. *J. Chem. Phys.*, **16**, 116–17 (*Feb.*, 1948).—Borazole, $B_3N_3H_6$, shows no absorption bands in the region 2 000 Å–4 600 Å, at pressures of about 2 atmos. in a 4-cm cell. Since bands analogous to those of benzene are expected on theoretical grounds, it is concluded that the analogues of the benzene 2 600 Å and 1 830 Å bands are the borazole 1 995 Å and 1 720 Å bands, with the analogues of the benzene 2 080 Å bands perhaps hidden in between. [See Abstr. 1295 (1948)]. A.

535.343.4–31 : 539.132 *see Abstr.* 1295

535.343.4–32 1207

Absorption of the alkyl cyanides in the vacuum ultra-violet. CUTLER, J. A. *J. Chem. Phys.*, **16**, 136–40 (*Feb.*, 1948).—The vacuum ultra-violet spectra of methyl an ethyl cyanide have been determined in the regic 1 000 Å to 1 800 Å. Three members of a Rydberg seri were found for methyl cyanide starting at 1 292 Å, th limit of the series corresponding to an ionization potenti of 11·96 eV. Vibrational band changes which have bee found to accompany the first two members have bee assigned to fundamental frequencies of the molecule b comparison with Raman data. The electronic transitio expressed by the Rydberg series, was ascribed to excitatio of a π electron in the triple bond. At higher pressure a continuous absorption appeared which was followe only to 1 600 Å. No structure could be observed in th spectrum of the ethyl cyanide, although it paralleled tha of methyl cyanide in having a stronger absorption startin at 1 342 Å and a weaker one appearing at higher pressure and spreading to longer wavelengths. A

535.371 120

The relation between efficiency and exciting intensity fo zinc-sulphide phosphors. KLASENS, H. A., RAMSDEN, W AND CHOW QUANTIE. *J. Opt. Soc. Amer.*, **38**, 60– (*Jan.*, 1948).—The effect of the intensity of the excitin radiation on the efficiency of ZnS phosphors activate with Ag and containing varying amounts of C $< 4\times10^{-4}$% has been studied at temperatures betwee −180° and 100°C. The results are in agreement with th theory of hole migration and show that the rate c recombination of electrons with ionized killing centres i much faster than that of electrons with ionized A centres. From the change of intensity-dependence wit temperature between 0 and 100°C the distance betwee the activator level and the full band was found to b 0·37 eV. To explain an anomalous result at low tem peratures with high Co concentrations, it is suggested tha shallow electron traps are present in the ZnS lattice. A

535.371.07 : 621.385.832.001.4 120

Testing long-persistence screens. TELLIER, J. C., ANI FISHER, J. F. *Electronics*, **21**, 126–30 (*Feb.*, 1948).— [Abstr. 1216 B (1948)].

535.375.5 121

Raman lines of second-order intensity in $SnBr_4$, $SnCl_4$ and CCl_4. WELSH, H. L., CRAWFORD, M. F., AND SCOTT G. D. *J. Chem. Phys.*, **16**, 97–105 (*Feb.*, 1948).—The characteristics of the faint Raman lines appearing in long exposures have been investigated. All the lines observed have been classified as overtones and combination tones of the fundamentals. The depolarizations of the second-order lines were measured by means of a Wollaston prism placed between the collimator lens and the dispersing prism of the spectrograph. The depolarizations were found to be in accordance with theory, on the assumption of tetrahedral symmetry for the molecules. The intensities of the second-order lines relative to the fundamentals were measured. For the spherically symmetrical frequencies it is shown that the observed intensities can be explained by assuming that electrical and mechanical anharmonicities are both operative; in some cases counteracting one another and in other cases enhancing the effect of each other. A

535.375.5 : 535.343–15 *see Abstr.* 1201

535.375.5 : 539.133 121

The Raman spectrum and structure of nickel carbonyl CRAWFORD, B. L., JR., AND HORWITZ, W. *J. Chem. Phys.*, **16**, 147–50 (*Feb.*, 1948).—A redetermination of the depolarization factors of the Raman lines shows the presence of only 2 polarized lines instead of 3, as previously reported by other investigators. The data obtained not only eliminate the only evidence against the

ahedral structure for this molecule but supply litional evidence in its favour. A.

.375.5 : 545.82 1212

Raman spectra of hydrocarbons. FENSKE, M. R., AUN, W. G., WIEGAND, R. V., QUIGGLE, D., MCCOR-CK, R. H., AND RANK, D. H. *Industr. Engng Chem. nalyt. Edit.*) **19**, 700–65 (*Oct.*, 1947).—The Raman ectra of 172 pure hydrocarbons are presented both as ectrograph records and in tabular form as scattering efficients and depolarization factors. Direct comrisons of spectra are possible because a uniform ensity scale has been used. Raman spectra can be used the qualitative and quantitative analysis of hydrobon mixtures. A few 9-component mixtures have been alysed successfully. In general, Raman spectroscopy hydrocarbon analyses is best used as a complement to ther than a substitute for the infrared and ultra-violetchniques. A.

5.375.5 : 545.82 1213

Correlation of intensity measurements in Raman spectra tained with different instruments. RANK, D. H. *dustr. Engng Chem.* (*Analyt. Edit.*) **19**, 766–7 (*Oct.*, 947).—The chief sources of error in intensity measureents in Raman spectra for analytical purposes are disssed. Three of the major causes of discrepancies tween observations of different observers using different struments are treated and suggestions are made for inimizing these errors. The variation in apparent tensity caused by variable polarization of Raman lines nd widely different transmission factors for plane olarized light for different spectrographs is discussed in etail. Equations are derived to enable polarization orrections to be made to the tabulated "scattering oefficients" [Abstr. 1212 (1948)]. By means of curves iven in the paper, scattering coefficients can be calulated approximately as they would be observed in ther spectrographs if the transmission factor for the wo kinds of plane polarized light is known. A.

35.376 : 539.164.08 *see Abstr.* 1309

35.39 1214

Optimum band width for two layer anti-reflection films. MUCHMORE, R. B. *J. Opt. Soc. Amer.*, **38**, 20–6 (*Jan.*, 948).—To determine the reflection from a two-layer nti-reflection film on glass the ideas and terminology of etwork analysis are introduced. This theory is shown o provide a clear physical picture of the field changes which occur with varying film parameters. It is shown hat there is a relation connecting these parameters which defines an optimum design for best bandwidth. This design yields a reflection curve having two points of zero reflection, and in a typical case gives $< 0{\cdot}005$ reflectivity over a range extending well beyond the visible spectrum at both ends. If, because of physical limitations, the optimum proves to be unattainable, then the conditions for closest approach are outlined. A.

535.417 1215

A new principle in interferometer design. PECK, E. R. *J. Opt. Soc. Amer.*, **38**, 66 (*Jan.*, 1948).—Each of the two mirrors of a normal Michelson interferometer is replaced by a pair of mirrors mounted at 90°. The reflection of such a mirror is not affected by rotation about the line of intersection of the pair, and it can thus be mounted on a rotating arm instead of a slide. A further development, using a triple mirror, or a glass corner-cube prism, and needing no angular adjustment at all, is discussed.

535.417 : 531.38.082.5 : 535.32 1216

A self-plotting interferometric optical system for the ultracentrifuge. PHILPOT, J. ST. L., AND COOK, G. H. *Research, Lond.*, **1**, 234–6 (*Feb.*, 1948).—The optical principle of the Rayleigh interference refractometer has been modified by adding a cylindrical lens which focuses the cell contents vertically in the final image, leaving the slit focused horizontally as before. This shapes the interference bands into graphs representing local difference of refractive index plotted against distance from the tops of the two cells. In this way the concentration distribution in ultracentrifuge, diffusion, electrophoresis, etc., cells can be automatically plotted by photography. The graphs are the integrals of those obtained by self-plotting Schlieren methods, so that concentrations can be read directly without the aid of a planimeter. Sedimentation of buffer salts, and similar effects which complicate Schlieren ultracentrifuge patterns, are automatically compensated in the interference patterns. A.

535.42 : 535.317 1217

The diffraction theory of optical aberrations. II. Diffraction pattern in the presence of small aberrations. NIJBOER, B. R. A. *Physica, 's Grav.*, **13**, 605–20 (*Dec.*, 1947).—[See Abstr. 1366 (1945)]. The diffraction theory for arbitrary aberrations of a symmetrical optical system is developed for the case of small aberration. The aberration function, which measures the deviation of the actual wavefront from a sphere, is expanded in a series of the "circle polynomials" introduced by Zernike [Abstr. 3570 (1934)]. This new expansion appears to have considerable advantages; for instance, the problem of the counterbalancing of aberrations of various orders can be solved completely. Formulae are given, from which the intensity distribution of the diffraction pattern in a receiving plane perpendicular to the principal ray in the neighbourhood of the Gaussian image can be numerically determined without much labour. The formulae are applied to the diffraction patterns of astigmatism and coma. The results of the numerical computations are given in diagrams showing the lines of equal intensity. A.

535.43 : 535.2 : 523.877 *see Abstr.* 1148

535.5 : 535.551 : 535.8 *see Abstr.* 1222

535.51 1218

Optical compensators for measurement of elliptical polarization. JERRARD, H. G. *J. Opt. Soc. Amer.*, **38**, 35–59 (*Jan.*, 1948).—A detailed survey is given of the present-day knowledge of optical compensators. The compensators discussed are those of Babinet, Soleil, Rayleigh, De Forest Palmer, Brace, Szivessy, Senármont, and Richartz. Each instrument is described, the theory developed, the method of use for the measurement of small phase differences given, and reference made to the sensitivity and accuracy. A.

535.51–15 : 539.13 : 548.75 :
535.343–15 *see Abstr.* 1202

535.514.2 1219

A transmitting polarizer for infra-red radiation. WRIGHT, N. *J. Opt. Soc. Amer.*, **38**, 69–70 (*Jan.*, 1948).—[See Abstr. 1845 (1947)]. A transmitting pile of 3 crystalline AgCl plates inclined at 26·5° to the beam can be used out to 15 μ.

535.551 : 535.5 : 535.8 *see Abstr.* 1222

535.642 1220

Errata: On two accessories of three-dimensional colorimetry. SILBERSTEIN, L. *J. Opt. Soc. Amer.*, **38**, 71–2 (*Jan.*, 1948).—See Abstr. 3137 (1946).

535.65 : 621.397.5 1221

Colorimetry in television. CHERRY, W. H. *RCA Rev.*, **8**, 427–59 (*Sept.*, 1947).—[Abstr. 1291 B (1948)].

535.8 : 535.31 *see Abstr.* 1192

535.8 : 535.5 : 535.551 1222

The optical system of polariscopes as used in photoelasticity. MYLONAS, C. *J. Sci. Instrum. Phys. Ind.*, **25**, 77–81 (*March*, 1948).—The uniformity of illumination of the optical field and the sharpness of the isochromatics are two indispensable conditions for a good polariscope. Their fulfilment depends on the size of the light source, on the sizes, focal lengths and respective positions of the condenser, collector and camera lenses, and finally on the thickness of the specimen. The necessary relations between these factors are determined and may be applied in choosing the components of a polariscope according to its intended use. A discussion on the need for a strongly illuminated field, as well as of a sharp image, shows that a compact and intense source is needed. A.

HEAT 536

536.22 : 532.74 1223

Thermal conductivity of liquids. PALMER, G. *Industr. Engng Chem.*, **40**, 89–92 (*Jan.*, 1948).—Hydrogen bonding in associated liquids is used to explain apparent anomalies in the thermal conductivity of glycols and alcohols. A plausible mechanism of heat conduction in these liquids is suggested, and, on the basis of this theory, an improved equation has been devised and tested on 48 liquids. A.

536.22 : 534.22 : 536.48 *see Abstr.* 1230

536.22 : 536.423.1 1224

Heat transfer through boiling liquid films. RUMFORD, F. *J. Soc. Chem. Ind.*, **66**, 309–12 (*Sept.*, 1947).—The rate of heat flow from a metal wall to a boiling fluid has been measured for water, toluene, ethyl alcohol and nitric acid. It has been shown that, where more than about 10% of the feed liquid is converted to vapour, the rate of heat transfer is not affected by mass velocity. It is also shown that boiling is not confined to any one zone in a vertical tube evaporator, but probably extends throughout the tube length. A.

536.23 : 533.16 1225

Note on the anomalous physical properties of processed atmospheric nitrogen. MINTER, C. C. *J. Appl. Phys.*, **19**, 217 (*Feb.*, 1948).—It has been found that cylinder N_2 (made from liquid air) has an abnormally low thermal conductivity, and high specific gravity and viscosity, relative to accepted values of pure N_2. No significant impurity could be found.

536.23 : 533.7 1226

Thermal conductivity of gaseous helium. UBBINK, J. B. *Commun. Suppl. K. Onnes Lab. Leiden* (*No.* 96*b*). *Physica, 's Grav.*, **13**, 629–34 (*Dec.*, 1947).—The theoretical relation $\lambda = f\eta c_v$ is tested by application of experimental values (λ = thermal cond.; η = viscosity; c = specific heat). The theoretical value $f = 2{\cdot}5$ is in good agreement with the available data (28 references) for all temperature regions. The temperature-dependence of λ was found to agree with de Boer's calculations [Abstr. 1275 (1943)], but no adequate theoretical basis for the pressure-dependence is available. A.

536.23.092 : 536.48 1227

Pressure dependence of the coefficient of heat conductivity for the gases helium and hydrogen at low temperatures. UBBINK, J. B. *Commun. K. Onnes Lab. Leiden* (*No.* 273*a*). *Physica, 's Grav.*, **13**, 659–68 (*Dec.*, 1947).—An apparatus is described to determine the pressure dependence of λ, even at high densities, with great accuracy. Measurements and results concerning He at 20 and 4·2°K and H_2 at 24°K are given. A.

536.252 1228

Temperature gradients for convection in well models. AULD, M. J. *J. Appl. Phys.*, **19**, 218 (*Feb.*, 1948).—The minimum temp.-gradient required to start convectio in 500-cm glass tubes of diameter 5, 7 or 9 mm filled wit water was measured. In all cases it was > Hales figur [*Mon. Not. R. Astr. Soc., Geophys. Suppl.*, **4**, 12 (1937)].

536.41 : 666 : 539.213 *see Abstr.* 1326

536.42 : 551.574 122

Sublimation in the atmosphere over the ocean CWILONG, B. *Nature, Lond.*, **161**, 62 (*Jan.* 10, 1948).— Threshold temperature for ice formation in a Wilso chamber in air over the Atlantic and Pacific oceans wa found to be −41·2°C, equal to that measured at th Jungfraujoch [Abstr. 2868 (1947)].

536.423 : 532.525 *see Abstr.* 1161

536.423.1 : 536.22 *see Abstr.* 1224

536.423.15 : 533.275 *see Abstr.* 1169

536.423.45 : 533.275 *see Abstr.* 1170

536.48 : 534.22 : 536.22 123

Second sound and the heat conductivity in helium II BAND, W., AND MEYER, L. *Phys. Rev.*, **73**, 226–8 (*Feb.* 1 1948).—By introducing a time of relaxation in a wav equation for second sound, (1) relations between th dispersion of second sound and ordinary sound ar derived; (2) the high heat conductivity of He II is relate to second sound in the same way as the normal hea conductivity is related to ordinary sound on Debye' theory; (3) values for the time of relaxation and th velocity of the heat flow are computed which are prac tically the same as for the flow of liquid He II through narrow slits above the critical velocity, indicating that ir both cases the restriction of the flow is due to the same mechanism. A

536.48 : 536.23.092 *see Abstr.* 1227

536.581.3 : 531.752 : 538.082.1 123

A new cryostat of the gas flow type and a quartz fibre microbalance adopted for magne-crystalline measurements BOSE, A. *Indian J. Phys.*, **21**, 275–84 (*Dec.*, 1947).— In the first part of the paper a description of a new form of automatically controlled gas-flow type of cryostat working between 300°K and 80°K, is given. The cryostat is suited to magnetic measurements on single crystals at low temperatures. The temperature can be maintained steady to ~ 0·01°C for long periods. In the latter parts the techniques for the measurement of anisotropies and that of principal susceptibilities at low temperatures is described. A quartz fibre torsion microbalance has been devised, specially for this latter measurement, with the help of which the forces on a crystal in an inhomogeneous field can be quickly and accurately measured. The same techniques could be extended down to liquid hydrogen or helium temperatures when available. A.

536.63 : 548.71 : 539.11 *see Abstr.* 1285

536.655 1232

Latent heat of vaporization, temperature and density of liquids. BOWDEN, S. T., AND JONES, W. J. *J. Soc. Chem. Ind.*, **66**, 342–3 (*Oct.*, 1947).—Simple relations are given for the variation of the latent heat of vaporization of non-associated liquids with the absolute temperature and the density. These relations are applicable over ranges of 50° and 100°, respectively, above the boiling point of the liquid. It is shown that the latent heat of vaporization of water $\propto$ (absolute temperature)$^{-\frac{1}{2}}$ for the range 100°–150°. A relation is also given for the variation of density of non-associated liquids with temperature. A.

THERMODYNAMICS 536.7

5.7 1233

Table and Mollier chart of the thermodynamic properties of 1, 3-butadiene. MEYERS, C. H., CRAGOE, C. S., AND JELLER, E. F. *J. Res. Nat. Bur. Stand., Wash.*, **39**, 1–22 (*Dec.*, 1947).

5.7 1234

On the thermodynamic substitution group and its representation by the rotations of a square. PRINS, J. A. *Chem. Phys.*, **16**, 65–6 (*Jan.*, 1948).—Thermodynamic symbols are distributed round a square. Substitutions of symbols by rotation of the square about certain axes or those which can be made in the general thermodynamic relations without falsifying them. This is a simplification of Koenig's statement [Abstr. 801 (1935)].

536.7 : 530.145 : 532.7 1235

Quantum corrections to the thermodynamic properties of liquids, with application to neon. RICE, O. K. *J. Chem. Phys.*, **16**, 141–7 (*Feb.*, 1948).—The quantum correction has been expressed as a deviation η from $\ln Q_c$, where Q_c is the classical partition function. Changes in volume, energy, specific heat, etc., caused by quantization can be expressed in terms of η and certain thermodynamic quantities. η itself is expressed in terms of thermodynamic quantities. The equations obtained give for solid Ne the same results, within the limits of error, as the usual treatment of a Debye solid with the aid of the Grüneisen relation. To apply the equation to liquid Ne, various thermodynamic quantities have been obtained from known values for A by use of the law of corresponding states. The difference in volume and specific heat of liquid Ne from the values expected from the law of corresponding states have been computed and found to agree reasonably well with the observations. However, the melting point, and the ΔE and ΔS of fusion are found experimentally to be much closer to the classical values than one would expect from the theory. No explanation for this discrepancy is apparent. A.

536.7 : 533.7 : 534.22 *see Abstr.* 1178

536.7 : 539.31 *see Abstr.* 1334

536.7 : 541.18.56 *see Abstr.* 1346

536.71 : 541.126 : 533.75 *see Abstr.* 1176

ELECTRICITY 537

537.133 1236

Range-energy relations for protons in substances containing C, H, O, A, and Xe. HIRSCHFELDER, J. O., AND MAGEE, J. L. *Phys. Rev.*, **73**, 207–15 (*Feb.* 1, 1948).—The Bethe theory was used to calculate the stopping power of protons in C, H, O, A, and Xe. The range-energy curves for protons in glycerol tristearate ($C_{57}H_{110}O_6$), paraffin ($(CH_2)_n$), A, and Xe are presented. The calculations for C, H, and paraffin are carried to 15 MeV, whereas all the others are only given up to 3 MeV. A.

537.212 : 534.213.4 : 621.392 1237

Errata: The electrostatic field of a point charge inside a cylinder, in connection with wave-guide theory. BOUWKAMP, C. J., AND DE BRUIJN, N. G. *J. Appl. Phys.*, **19**, 213 (*Jan.*, 1948).—See Abstr. 2551 (1947).

537.226 1238

Dielectric properties of aqueous ionic solutions. I–II. STED, J. B., RITSON, D. M., AND COLLIE, C. H. *J. Chem. Phys.*, **16**, 1–21 (*Jan.*, 1948).—The permittivity and loss angles of a series of concentrated aqueous ionic solutions have been measured at wavelengths of 10 cm, 3 cm, and 1·25 cm. From these results the values of the static permittivity and relaxation time for these solutions have been calculated on the basis of the Debye formula, which appears to hold accurately. All salts show a lowering of the permittivity and a shift in the relaxation time of water. It is found that the permittivity κ can be represented by a formula $\kappa = \kappa_\omega + 2\delta c$, where κ_ω is the permittivity of water, c is the concentration in moles/litre, and δ has values between -7 and -15 for various salts in concentrations of up to 2M. The measurements are described and the results discussed in relation to the structure of ionic solutions. The validity of the Debye–Sack saturation theory of the permittivity and the effects of the fall of permittivity on the electrolytic properties of concentrated solutions are discussed. A.

537.226 : 539.23 : 537.529 *see Abstr.* 1252

537.228.1 : 549.514.51 *see Abstr.* 1386

ELECTRIC CURRENTS 537.3

537.3 : 537.533 : 530.162 : 621.38 1239

The Brownian movement and spontaneous fluctuations of electricity. MACDONALD, D. K. C. *Research, Lond.*, **1**, 194–203 (*Feb.*, 1948).—A brief critical review of the treatment of the various electrical manifestations of fluctuation phenomena. A bibliography of 106 references is provided.

537.3 : 537.533 : 530.162 : 621.38 1240

On the theory of electrical fluctuations. FÜRTH, R. *Proc. Roy. Soc. A*, **192**, 593–615 (*March* 18, 1948).—A critical analysis of the fundamental principles of the theory of "thermal fluctuations of electricity" is given, and a new derivation of Nyquist's theorem is presented. It is shown that the two types of electrical fluctuation phenomena, namely, the "thermal fluctuation" and the "shot effect," are in fact identical, in spite of the apparently different origin of the fluctuations. For this purpose the methods for the derivation of the expressions for the shot fluctuations and their meaning are critically analysed, and the reasons discussed which lead to the above-mentioned conclusion. Finally, on the basis of this idea, a tentative derivation of a general formula for the shot-effect in diodes is given which ought to be valid throughout the whole range of the characteristic. A.

537.311.32 : 548.0 1241

Technique for obtaining increased range and mobility of free electrons in silver chloride. HAYNES, J. R. *Rev. Sci. Instrum.*, **19**, 51 (*Jan.*, 1948).—Details of grinding, etching and annealing are given.

537.311.33 : 535.215.2 : 537.533 *see Abstr.* 1254

537.311.33 : 537.312.6 *see Abstr.* 1243

537.311.33 : 537.323 *see Abstr.* 1244

537.311.33 : 539.23 : 537.311.4 *see Abstr.* 1242

537.311.4 : 537.311.33 : 539.23 1242

The influence of surface films on the electrical behaviour of contacts. DILWORTH, C. C. *Proc. Phys. Soc., Lond.*, **60**, 315–25 (*April*, 1948).—The variation of current with voltage at an idealized contact between two crystals of a semiconductor is calculated on the assumption that electrons penetrate the surface barrier by tunnel effect. Comparison with experimental curves for silicon carbide powders leads to the conclusion that these crystals are covered by an insulating surface film, which affects the rectifying properties of the crystal when it is in contact with a metal. It is shown that this can account for the discrepancies observed between experimental curves and those deduced from the simple Schottky theory of rectification. A

537.312.6 : 537.311.33 1243

Temperature coefficient of electrical resistivity for crystalline selenium containing various percentages of bromine. BLACKBURN, W. E. *J. Appl. Phys.*, **19**, 51–4 (*Jan.*, 1948).—The coefficient of brominated Se from − 30 to 100°c was found to be negative and variable. The electrical resistivities of the samples varied by factors of 3–12 for the temperature range mentioned, depending upon the Br content. A reproducible hysteresis loop was obtained on the plot of resistivity *v.* temperature. A minimum in the plot of electrical resistivity *v.* Br content was found at 0·007%. Activation energies for freeing electrons obtained from the slopes of conductivity *v.* temperature plots indicate a dependence upon Br content. A.

537.323 : 537.311.33 1244

Variation of thermo-electric power of electronic semi-conductors with vapour pressure. HOGARTH, C. A. *Nature, Lond.*, **161**, 60–1 (*Jan.* 10, 1948).—The principle of mass action is applied to determine the effect of varying the vapour pressure of one of the constituents of the substance. The resulting formula $dE/dT = -C_T \log P_v \pm$ const. is shown to yield values of C_T in close agreement with experimental values derived from Cu_2O, NiO and ZnO.

537.363 : 541.182.62 1245

Electrophoretic deposition of powdered materials from non-aqueous suspensions. HILL, C. G. A., LOVERING, P. E., AND REES, A. L. G. *Trans. Faraday Soc.*, **43**, 407–17 (*July*, 1947).—A theoretical approach to the problem has been made, taking into account the mutual interaction of the particles. Quantitative experiments have been carried out lending support to the theoretical predictions. The effect of high polymers dissolved in the liquid medium on the electrophoresis of the particles is described and a possible explanation of this effect suggested. A.

ELECTRIC DISCHARGES AND RADIATIONS 537.5

537.521 : 537.56 1246

Ionization currents in divergent fields in hydrogen and in air. JOHNSON, G. W. *Phys. Rev.*, **73**, 284–97 (*Feb.* 15, 1948).—Ionization currents were measured in H_2 and in dry, Hg-free air between concentric cylinders for pressures from 0·01 to 760 mm. Above the pressures corresponding to the minimum sparking potentials, $(1/rp) \log i/i_0$ was a single-valued, continuous function of $(X/p)_{max}$. Calculated values of apparent α for air agreed with uniform field values at low X/p but were high at higher X/p. In H_2 apparent α was high over the full range of variables studied. Auxiliary anodes permitted estimates of the location of the ionization, which was found to agree with the spatial distribution predicted by Morton. Electrons released in the low and collected in the high field produced the same ionization as for the reverse case except at low pressure in H_2 where about 10% less ionization occurred for electrons released in the low field. The peaks of Morton's i/i_0 *v. p* curves [Abstr. 121 (1947)] were identified with the minimum sparking potential. Application of the back diffusion equation of Rice [Abstr. 3165 (1946)] permitted the evaluation of i_0 at higher pressures than hitherto has been possible. Comparison with results of Fisher and Weissler [Abstr. 607 (1945)] show that the present results can be directly applied if the focal length of the point parabola is substituted for r in the electron multiplication parameter. On this basis it is expected that the present values of the parameter may be applied to any geometry in which the field $\propto$ 1/(distance from a fixed point). A necessary condition for the application of the observed values of the parameter to any system is that the electrons give up all of their ionizing energy to the gas before being collected. [α = 1st Townsend Coeff.] A.

537.525 124

Comparative studies of *Joshi-effect* under single and bi-phase half-wave detection. PRASAD, B. B. *Indian J. Phys.*, **21**, 295–301 (*Dec.*, 1947).

537.525.72 124

Theory of high frequency gas discharges. I. Method for calculating electron distribution functions. MARGENAU, H. *Phys. Rev.*, **73**, 297–308 (*Feb.* 15, 1948).—After a summary of the "free-electron" theory of alternating currents in gases, which is shown to be inadequate for microwaves, methods for calculating distribution functions for electrons with consideration of all types of collisions are developed and discussed. Conditions are specified under which non-elastic collisions may be introduced as integral and as differential expressions in the Boltzmann transfer equation. This equation is solved approximately and the differences between direct current and h.f. current discharges are pointed out. Finally, an aspect of what is usually called Paschen's law is discussed; it indicates that a minimum should exist in the graph of voltage *v.* pressure, and of voltage *v.* frequency, both at constant current. This minimum comes when the frequency of the field $\simeq$ the collision frequency of the electrons. A.

537.525.72 124

Theory of high frequency gas discharges. II. Harmonic components of the distribution function. MARGENAU, H. AND HARTMAN, L. M. *Phys. Rev.*, **73**, 309–15 (*Feb.* 15, 1948).—The type of distribution function employed in I is not sufficiently general to be applicable to all conditions of frequency and field strength. To examine its limitations, and the limitations of corresponding d.c. treatments, the function is developed as a series in Legendre polynomials of v_x/v, x being the field direction, and Fourier functions of ωt, ω being the field frequency. Attention is limited to steady states and to elastic collisions between electrons and gas molecules. By solving the resulting recurrence equations a number of successive approximations has been obtained, and from each approximation the range of validity of the preceding one is determined. Questions of mathematical convergence are not dealt with, since the physical meaning of the results is usually clear and reasonable. The current through the gas is shown to take on d.c. character when $\omega\lambda \ll (m/M)v$, λ being the mean free path and v the (mean) velocity of the electrons producing the current. A.

537.525.72 125

Theory of high frequency gas discharges. III. High frequency breakdown. HARTMAN, L. M. *Phys. Rev.*, **73**, 316–25 (*Feb.* 15, 1948).—In search of a definition of "breakdown" of a gas under microwave fields, the density of electrons is investigated as a function of the field strength under the following simplifying assumptions: Ionization occurs as result of single impacts between gas atoms and sufficiently fast electrons. The gas has an infinite volume, and negative ions are not formed, so that the only mechanism for electron removal is recombination with positive ions. The calculations show that, at a certain field strength, the density of electrons rises sharply. The simple model, therefore, leads to a breakdown phenomenon, at field strength not far from observed values. Gases treated are He and Ne under frequencies of the order of 3 000 Mc/s.

.525.72 1251

heory of high frequency gas discharges. IV. Note on similarity principle. MARGENAU, H. *Phys. Rev.*, **73**, -8 (*Feb.* 15, 1948).—The similarity principle of Steen-k is derived from the differential equation for the :tron distribution function and is extended to cover discharges. Possible applications and its limitations discussed. A.

.529 : 537.226 : 539.23 1252

.he electric strength of dielectric films. PLESSNER, W. *Proc. Phys. Soc., Lond.*, **60**, 243–56 (*March*, 8).—An attempt was made to verify the rise in electric :ngth predicted by Fröhlich's theory [Abstr. 3411 39), 2160 (1941)] as the thickness of the dielectric cimen approaches the electronic mean free path. The ılts obtained on a number of crystalline and amor-ous materials are given and discussed in relation to theory. A.

.531 : 535.33 1253

X-ray spectrum of element 43. BURKHART, L. E., PEED, F., AND SAUNDERS, B. G. *Phys. Rev.*, **73**, 347–9 (*Feb.* 1948).—The spectrum of a sample containing Element has been studied. Lines ascribable to $K\alpha_1$, $K\alpha_2$, $K\beta_1$, $_2$ of Element 43 were identified. Their wavelengths lowed closely the values calculated by interpolation ween elements 41, 42, 44, and 45. A.

.531 : 535.343.2 : 539.11 *see Abstr.* 1284

.531 : 537.542 *see Abstr.* 1260

.531 : 539.319 *see Abstr.* 1335

.531 : 615.849 *see Abstr.* 1378

7.533 : 530.162 : 621.38 : 537.3 *see Abstr.* 1239–40

7.533 : 535.215.2 : 537.311.33 1254

Energy distribution of photoelectrons from poly-stalline tungsten. APKER, L., TAFT, E., AND DICKEY, *Phys. Rev.*, **73**, 46–50 (*Jan.* 1, 1948).—Total-energy tributions of the photoelectrons from aged poly-stalline W ribbons, with the usual rolling texture, were ermined by applying retarding potentials to spherical lectors. Particular attention was paid to the region low energy. When stray fields were eliminated, energy-tribution functions rose linearly with energy. The rage work function was determined by extrapolation (current)‡ voltage curves to the saturation line. The ult agreed with the value 4·49 eV determined both m the spectral distribution and from the temperature-iation of the photo-current. Application of spherical oto-cells to investigations of semiconductors is dis-ssed briefly. A.

7.533.73 : 539.133 *see Abstr.* 1299

7.533.74 1255

Method of projected angles in cloud chamber measure-nts. BARKER, F. C. *J. Sci. Instrum. Phys. Ind.*, **25**, -7 (*March*, 1948).—The advantages of the method in measurement of scattering processes are discussed, d tables are given to enable comparison of experiment th theory. A.

7.533.74 : 539.152.1 *see Abstr.* 1302

7.533.8 : 537.561 *see Abstr.* 1264

7.534 : 537.542 *see Abstr.* 1261

7.534.74 1256

A phase-shift analysis of the scattering of protons by uterons. CRITCHFIELD, C. L. *Phys. Rev.*, **73**, 1–6 (*Jan.* 1948).—Numerical values for the *S*-wave and *P*-wave ase shifts are deduced from the observed angular stribution of protons scattered by deuterons. Experimental results obtained in the energy range, 1·5 to 3·5 MeV, are used. In reducing the results to phase shifts the theoretical work on neutron-deuteron scattering, as presented by Buckingham and Massey [Abstr. 1727 (1947)], was used as a guide. It is found that the *p-d* phase shifts are qualitatively similar to the calculated *n-d* phase shifts, for the case of exchange forces between nucleons, except that the doublet *P*-wave is much more strongly refracted in the *p-d* results. The discrepancy may be evidence for a difference between the actual nuclear forces and the type of central, exchange forces assumed in the calculations. The results are definitely not similar to those for ordinary forces, however, and such forces would appear to be ruled out. Phase shifts in *S*- and *P*-waves alone are not sufficient to represent the *p-d* results in the range of energies used, but it is necessary to include interference with *D*-waves. A.

537.542 1257

The properties of some new types of counters. CURRAN, S. C., AND REID, J. M. *Rev. Sci. Instrum.*, **19**, 67–75 (*Feb.*, 1948).—It is generally assumed that it is essential to use a cylinder of circular section as the cathode if a good counter of the point or wire type is to be made. Investigation of various geometrical forms of cathode with a wire as anode shows that counters may be made in a large variety of shapes and yet operate satisfactorily. Thus a large rectangular vessel with a wire placed symmetrically within the volume or mounted close to one wall has been found to operate as a self-quenched counter. The use of such shapes is shown to result in improved performance in several important respects, e.g. reduced operating voltages, shorter dead-times. By the use of several wires in the same vessel, coincidence arrangements are made easily possible. This can be applied successfully to the construction of a counter which has a reduced natural counting rate but still presents a large solid angle to an external source. Various other applications are considered. A.

537.542 1258

Short time delays in Geiger counters. SHERWIN, C. W. *Rev. Sci. Instrum.*, **19**, 111–15 (*Feb.*, 1948).—There are at least two types of short time delays in the firing of Geiger counters. The first is due to the transit time of the secondary electrons as they migrate toward the central wire. This time can be measured when β-particles are sent parallel to the axis of the counter, creating secondaries at known distances from the axis. In a typical counter, 2·2 cm in diameter, the maximum secondary electron transit time is measured at $\sim 11 \times 10^{-8}$ sec. The second delay occurs between the time the electron arrives near the centre wire, and the time a pulse is detected on the output of a wide-band amplifier connected to the centre wire. Increasing the voltage on the counter from the threshold to an over-voltage of 250 V, decreases this delay by 10 to 20×10^{-8} sec. It is suggested that this delay is due to the time required to form the initial part of the ion sheath. A.

537.542 1259

Some experiments with Geiger–Müller counters. CRAGGS, J. D., BOSLEY, W., AND JAFFE, A. A. *J. Sci. Instrum. Phys. Ind.*, **25**, 67–71 (*March*, 1948).—The paper describes a simple counting circuit and various types of Geiger–Müller counter. Representative plateau curves are shown for normal cylindrical counters and for parallel plate/wire counters. The latter are shown to have directional response if a suitable thin window is provided. A simple method for the suppression of delayed cathode emission (Paetow effect) is also outlined. (Bibliography of 23 refs.) A.

537.542 : 537.531 1260

Recovery time of Geiger counters for X-ray intensity measurement. PEPINSKY, R., JARMOTZ, P., LONG, H. M., AND SAYRE, D. *Rev. Sci. Instrum.*, **19**, 51–2 (*Jan.*, 1948). —Observations made with a pulsed X-ray tube showed that a Geiger counter has a dead-time of 100 μsec, and only recovers full sensitivity to X-ray photons 150 μsec after a counter discharge.

537.542 : 537.534 1261

A study of adjustments of a Zinn-type ion source. JORGENSEN, T., JR. *Rev. Sci. Instrum.*, **19**, 28–30 (*Jan.*, 1948).—The ion current from the source [Abstr. 5130 (1937)] has been determined for various values of 3 parameters: diameters of the probe and plate holes and the spacing of the nose and plate. It was found to increase linearly with the diameter of the plate hole up to a certain value; above this there was little further increase. It likewise increased with probe hole diameter, but the increased gas flow prevented extensive increases in this parameter. A smaller gap between nose and plate gave the maximum ion current for a smaller current to the filament and therefore at a smaller power dissipation in the arc. Gas consumption was 10 cm³/hr. A.

537.542 : 539.164.08 *see Abstr.* 1310

537.56 : 537.521 *see Abstr.* 1246

537.56 : 621.385 : 621.396.645 1262

On the natural precision of linear ionization chamber amplifiers. KELLER, K. J. *Physica, 's Grav.*, **13**, 326–36 (*Aug.*, 1947).—[Abstr. 1266 B (1948)].

537.561 1263

Ionization potentials of some hydrocarbon series. HONIG, R. E. *J. Chem. Phys.*, **16**, 105–12 (*Feb.*, 1948).—A new method is described which permits ionization and appearance potentials to be determined reproducibly, within $\pm$ 0·02 V, by electron impact in a conventional 180° mass spectrometer. The energy spread of the ionizing electrons, while not eliminated, is accounted for in an analytical expression that describes the ionization efficiency curve of A near the initial upward break. It is shown that an ionization or appearance potential can be determined graphically by drawing a tangent of critical slope to the efficiency curve which has been plotted on a semilog scale. Absolute values are obtained by referring the unknown to the ionization potential of a calibrating gas (usually K). For the monatomic gases studied, electron impact and spectroscopic values agree within the experimental uncertainty. For some known polyatomic molecules, the "vertical" impact values exceed the "adiabatic" spectroscopic potentials by 0·02 to 0·2 V, depending on molecular complexity. Paraffins, 1-olefines, and 2-olefines show a systematic reduction in potential with chain length. A similar decrease is observed when the mono-olefines are arranged according to the number and size of substitutions on the basic ethylene structure. A.

537.561 : 537.533.8 1264

Dissociation of SF_6, CF_4, and SiF_4 by electron impact. DIBELER, V. H., AND MOHLER, F. L. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 25–9 (*Jan.*, 1948).—The dissociation has been studied with a mass spectrometer. Data are also given on the appearance potentials of various ions in the mass spectra and measurements on the isotope abundance of S, C, and Si. The observed appearance potentials of the F^+ ion in SF_6 and CF_4, and the C^+ ion in CF_4 were found to be $<$ the calculated value assuming formation of a + atom ion and a free electron, but $\simeq$ the calculated value assuming the formation of a + atom ion and a F^- ion. The large relative abundance of th SF_4^{++} ion in SF_6 and the CF_2^{++} ion in CF_4 is taken indicate the formation of these ions by removal of tw F^- ions in the former and possibly an F^- ion and a fr electron in the latter case.

537.581 12

Thermionic emission constants and band overla WOHLFARTH, E. P. *Proc. Phys. Soc., Lond.*, **60**, 360- (*April*, 1948).—A general treatment is given of the effe of band overlap on thermionic emission. The results a applied to Ni, for which the experimental value of th current constant A of 1 380 A/cm² deg² differs marked from the standard value of 120 A/cm² deg². The case Ni has recently been discussed by Sun and Band [Abst 808 (1946)], who derive an expression for the variation A with temperature. It is shown that their relatio strictly applies only to "holes" in an isolated d-band an is reliable only over a temperature range such th $kT/\varepsilon_{0d} \ll$ unity, ε_{0d} being the unoccupied width of th d-band. With an overlapping s-band, as in Ni, there is a increasing transfer of electrons from the d-band as th temperature rises. The effect is strongly dependent on th ratio $r_0 = \varepsilon_{0s}/\varepsilon_{0d}$, where ε_{0s} is the occupied width of th s-band. Expressions are derived and precise calculatior carried out for the transfer effect and the variation of over a range $0 \leqslant kT/\varepsilon_{0d} \leqslant 1$ (including temperature up to about 2 000°K), and for r_0 values of 10, 20 and ∞ The last corresponds in effect to an isolated d-band. Th results of the calculations are shown in figures. A com parison with the experimental value of A is made using value of ε_{0d} estimated from thermal and magnetic dat The satisfactory agreement previously obtained is due t the adoption of a value of the bandwidth which is in compatible with the experimental evidence, and it shown that the calculated and observed values of actually differ by a factor of ~ 6. Various reasons fo this discrepancy are discussed, especially the effect surface impurities.

COSMIC RAYS 537.591

537.591.08 : 539.16.08 : 621.318.57 126

Electronic sequence control circuit for the operation a Wilson cloud chamber. ALLEN, F. L. *Rev. Sci. Instrum* **19**, 24–7 (*Jan.*, 1948).—The circuit is used in cosmic-ra work. Necessary delays are introduced by unbalance multivibrator circuits whose periods are adjustable b means of potentiometers. The circuit operating th magnetic-type valve makes use of two thyratrons, one t conduct the valve current and the second to interrupt i permitting large values of this valve current and there fore fast action. Minor modifications readily adapt th circuit to a chamber used in other investigations.

537.591.15 : 537.591.8 126

Penetrating showers in lead. FRETTER, W. B. *Phy Rev.*, **73**, 41–5 (*Jan.* 1, 1948).—Production of penetratin showers in Pb has been observed in a cloud chambe containing 8 ½-in thick Pb plates. In over half of the 5 examples photographed, high-energy electronic radiatio was simultaneously produced. Many examples c mesons accompanying air showers were observed, but n production of penetrating particles in Pb by electroni radiation was observed. The pictures taken give genera support to recent theoretical speculations that the primar radiation produces penetrating particles and electroni radiation in the same event.

537.591.15 : 539.18 : 530.145 *see Abstr.* 1152

591.3 1268

ne absorption of high energy electrons in cosmic ation. SCHEEN, W. L. *Physica, 's Grav.*, **13**, 669–88 , 1947).—The probability for an electron of given gy of passing through a layer of material is discussed, ming the Furry model, and taking into account the ossibility of distinguishing the original electron from of its secondaries. The result is given in the form of range of the electron in the material. A.

591.5 1269

he cosmic-ray counting rate of a single Geiger counter n ground level to 161 kilometers altitude. VAN ALLEN, ., AND TATEL, H. E. *Phys. Rev.*, **73**, 245–50 (*Feb.* 1, 8).—The measured rate is shown in a graph. The pment was carried in a V-2 rocket at geomagnetic ude $\lambda = 41°$N. Especial care was taken to avoid tiplicative effects from surrounding material. A e of the charged primary cosmic-ray flux of 0·12/sec/cm²/steradian, averaged over the upper isphere, is implied by the data above 55 km. This rpretation of the counting rate must be qualified by as yet unknown contribution from secondaries which rge from the atmosphere and execute orbits in the h's magnetic field. A.

.591.8 1270

lectronic component of cosmic rays in the low atmo-ere. I. Theoretical. BERNARDINI, G., CACCIAPUOTI, N., AND QUERZOLI, R. *Phys. Rev.*, **73**, 328–34 (*Feb.* 15, 8).—The authors discuss the problem of the equili-ium conditions between meson and secondary elec-ic component. Following William's concept of *tron track*, some formulae are deduced for the number electrons with energy $\geqslant \eta$ generated in Coulombian lisions and in equilibrium with the meson component, a substance having a critical energy ε_c. Similarly a eral formula is given for the number of disintegration ctrons in equilibrium with the meson component in nosphere. Such formulae present a remarkable erality because they include the fundamental para-ters explicitly, and the meson spectrum appears in m in integral form; this makes them particularly table for comparison with experiments. With the of these formulae the following calculations have been rformed: (*a*) Number of secondary electrons generated Pb and in equilibrium with the meson component for = 2, 3, 4, 5 MeV and for different values of the lower nit of meson energy; (*b*) number of secondary collision ctrons arising from the atmosphere for different values η at sea level and at 3 500 m above sea level; (*c*) number secondary disintegration electrons for different values the cut-off energy, etc. A.

7.591.8 1271

Electronic component of cosmic rays in the low atmo-here. II. Experimental. BERNARDINI, G., CACCIA-OTI, B. N., AND QUERZOLI, R. *Phys. Rev.*, **73**, 335–9 *eb.* 15, 1948).—A comparison is made between the sults of some cosmic ray counter experiments and the merical values obtained in I for the number of condary electrons in the low atmosphere. This com-rison seems to give the following conclusions: (*a*) Even 3 000–4 000 m above sea level the electron component not in equilibrium with the meson component, gardless of what may be the background of slow sons; (*b*) at 3 500 m the electronic component contains me electrons of high energy which are not secondaries mesons with 2·3 μsec lifetime; (*c*) the slow mesons are gligible at sea level and their intensity increases rapidly th height, roughly as the electron component. A.

7.591.8 : 537.591.15 *see Abstr.* 1267

MAGNETISM 538

538.082.1 : 531.752 : 536.581.3 *see Abstr.* 1231

538.114 : 621.317.41.029.64 : 538.213.08 *see Abstr.* 1272

538.213.08 : 538.114 : 621.317.41.029.64 1272

The measurement of the permeability of low-conductivity ferromagnetic materials at centimetre wavelengths. BIRKS, J. B. *Proc. Phys. Soc., Lond.*, **60**, 282–92 (*March*, 1948).—A waveguide impedance method is described, which avoids the difficulties and anomalies present in earlier measurements. The complex magnetic and dielectric properties of a specimen filling a section of waveguide are derived from standing-wave measurements of the short-circuit and open-circuit impedances of the section. The experimental apparatus and techniques which have been employed at wavelengths of 60–20 cm, 15–6 cm, 3 cm and 1¼ cm are described, and some typical results of measurements on γ-ferric oxide are given. It is shown that the observed magnetic dispersion is an inherent property of the material, and is not attributable to skin-effect. [See Abstr. 368 (1948)]. A.

538.221 1273

On the theory of ferromagnetic resonance absorption. KITTEL, C. *Phys. Rev.*, **73**, 155–61 (*Jan.* 15, 1948).—The theory of ferromagnetic resonance absorption previously developed [Abstr. 1574 (1947)] is extended to include the effect of the shape of the specimen and, in the case of a single crystal, the effect of crystal orientation. The resonance condition may be written $\omega_0 = \gamma H_{\text{eff}}$, where $H_{\text{eff}} = (BH)^{\frac{1}{2}}$ for a plane surface, $H + 2\pi M$ for a long circular cylinder, and H for a sphere; the latter two values apply only to the situation in which the eddy current skin depth $\geqslant$ the radius of the specimen. In the case of an uniaxial crystal with the axis parallel to the static magnetic field, the value of H to be used in the resonance conditions is increased by $2K/M$, where K is the anisotropy constant. The case of a cubic crystal is also considered. A detailed discussion of macroscopic eddy-current effects is given, and it is shown that the usual eddy-current losses do not introduce damping terms into the expression for the permeability, when properly interpreted. A.

538.222 : 535.343.2–14 1274

Crystalline Stark splitting and microwave resonance absorption in paramagnetic salts. KITTEL, C., AND LUTTINGER, J. M. *Phys. Rev.*, **73**, 162–72 (*Jan.* 15, 1948).—A theoretical discussion is given of the application of microwave-absorption measurements to the determination of energy levels in single crystals of paramagnetic salts. Selection rules are given for magnetic-dipole transitions between sublevels in the presence of crystalline electric fields of cubic, tetragonal, trigonal and rhombic symmetry. The Zeeman effect in the presence of crystalline electric fields is discussed in some detail for three special cases: (*a*) $J = 5/2$, cubic field; (*b*) $J = 7/2$, cubic field; (*c*) $J = 3/2$, trigonal field. These examples may correspond approximately to certain magnetically dilute salts containing Fe^{+++}, Gd^{+++} and Cr^{+++} ions, respectively, provided that exchange interactions do not play an important role and that the assumed symmetries are approximately correct. Numerical values are tabulated for the relative frequencies and line strengths associated with magnetic-dipole transitions in the cases discussed. The character of the spectra may change radically between the limit where the Zeeman splitting is small in comparison with the Stark splitting, and the opposite limit where the Stark splitting may be neglected. A.

538.222 : 539.152.2 1275

Paramagnetic spin absorption in some hydrated and anhydrous paramagnetic salts. VOLGER, J., DE VRIJER, F. W., AND GORTER, C. J. *Physica, 's Grav.*, **13**, 621–8 (*Dec.*, 1947).—The absorption was measured in some hydrated and anhydrous salts of Fe^{+++}, Mn^{++}, Cr^{+++}, Cu^{++} and Gd^{+++} at 78 Mc/s at 90 and 77°K. Results are compared with Broer's theory for spin relaxation. A.

538.222 : 539.152.2 1276

Paramagnetic spin absorption of meter waves in $Fe(NH_4)(SO_4)_2 . 12H_2O$ and $CrK(SO_4)_2 . 12H_2O$ at 77° and 90°K. VOLGER, J., DE VRIJER, F. W., AND GORTER, C. J. *Physica, 's Grav.*, **13**, 635–42 (*Dec.*, 1947).—The absorption was studied in parallel and perpendicular constant magnetic fields at liquid air temperatures at 78 Mc/s. Measurements at such a high frequency yield reliable data for the spin absorption, while earlier measurements at lower frequencies were chiefly determined by lattice absorption. The results concerning spin relaxation times and their dependence on the constant magnetic fields differ from previous determinations. These may have suffered from the disturbing influence of transition points of the alums in this region of temperatures. A.

538.222 : 539.152.2 1277

Paramagnetic absorption in manganous ammonium sulphate hexahydrate. VOLGER, J., DE VRIJER, F. W., AND GORTER, C. J. *Physica, 's Grav.*, **13**, 653–8 (*Dec.*, 1947).—The absorption has been investigated at 195 and 90°K in a wide interval of frequencies, permitting the separation of lattice absorption and spin absorption. At medium frequencies a small extra absorption was detected in high constant parallel fields, the nature of which is unknown. The relaxation time of lattice absorption varies with the constant field in agreement with Van Vleck's theory. The relaxation time of spin absorption is twice the value expected by Broer and unexpectedly proves itself to be very little dependent on a parallel constant field. A.

538.224 : 538.614 : 541.64 : 541.24 *see Abstr.* 1353

538.24 1278

The adiabatic temperature changes accompanying the magnetization of some ferromagnetic alloys in low and moderate fields. BATES, L. F., AND HARRISON, E. G. *Proc. Phys. Soc., Lond.*, **60**, 213–25 (*March*, 1948).—The method of Bates and Weston [Abstr. 147 (1941)] for measuring the small heat changes which occur as a ferromagnetic substance is taken through a single hysteresis cycle step by step was applied to 7 ferromagnetic alloys. In every case a cooling was initially observed as the magnetization of the specimen was reduced from its maximum value. Indications were found that large changes in thermomagnetic properties are caused by small changes in composition, particularly when the latter approximates to that of Invar. The results are discussed in terms of the modern domain concepts of ferromagnetic processes. A.

538.24 1279

The adiabatic temperature changes accompanying magnetization in low and moderate fields: a further study of iron. BATES, L. F., AND HARRISON, E. G. *Proc. Phys. Soc., Lond.*, **60**, 225–36 (*March*, 1948).—Using an improved instrument [see Abstr. 147 (1941)] further studies were made of a specimen of annealed Armco Fe previously studied [Abstr. 1706 (1943)] on a specimen of H.S. electrolytic Fe. Heat changes associated with the virgin magnetization curve were obtained for the first time. A.

538.24 12

The Barkhausen effect. BUSH, H. D., AND TEBBLE, R. *Proc. Phys. Soc., Lond.*, **60**, 370–81 (*April*, 1948).—A n method of investigating the effect is described. T number of discontinuities occurring is counted, and knowledge of the change in magnetic moment associat with each one, leads to information concerning t volume of material associated with a discontinuity. T change in magnetization due to discontinuities, and t distribution of number and size over the hysteresis cyc are obtained. Conclusions are drawn that the d continuities associated with volumes $> 0{\cdot}9 \times 10^{-9}$ c only account for $\sim 30\%$ of the total change in ma netization. Possible explanations of these results a discussed, and suggestions made as to the furth development of the method.

538.245 12

Magnetization curves for ferromagnetic single crysta LAWTON, H., AND STEWART, K. H. *Proc. Roy. Soc.* **193**, 72–88 (*April* 22, 1948).—Magnetization curves f Fe single crystals above the "knee" are derived on t basis of domain theory for the case where the specim is finite and the field is applied in an arbitrary directi with respect to the crystal axes. The shape of the spe men is important for the magnetization process and it shown that in many cases the demagnetizing field mu be such as to make the field actually acting in the cryst have a direction of symmetry (e.g. [111] or [110]) wha ever the direction of the applied field. The cases of a oblate spheroid with its equatorial plane a (100) plan of the crystal and of a long rod with arbitrary orientatio are considered in detail. In these cases simple expressio for the magnetization curves are obtained. There is goo agreement with the experimental results of various autho for both parallel and normal components of magnetiz tion. A method for correcting for the effect of intern strains is indicated.

ELECTROMAGNETISM . ELECTRODYNAMIC
538.3/.5

538.56 : 535.312 : 621.396.11 128

A general divergence formula. RIBLET, H. J., AN BARKER, C. B. *J. Appl. Phys.*, **19**, 63–70 (*Jan.*, 1948).— A divergence expression for the ratio of energy p steradian reflected from a smooth curved surface to th incident on the surface is derived. It generalizes previou results in that the source and point of observation ma both be at finite distances from the reflecting surfac No restrictions are placed on the angles of incidence an reflection except that they be equal. The only limitatio placed on the analytical accuracy of the geometrica result is that the surface be sufficiently smooth so that th principal radii of curvature are defined at the point o reflection; it is required that the wavelength of the energ $\ll$ the principal radii of curvature of the surface. All o the known previous results on this problem are derive as special cases. Application of the result in connectio with the spreading of radio rays by the curvature of th earth leads to somewhat simpler formulae than nov available.

538.566 : 621.396.821 128

A possible mode of propagation of the "slow" or tai component in atmospherics. HALES, A. L. *Proc. Roy Soc. A*, **193**, 60–71 (*April* 22, 1948).—A possible surfac wave mode of propagation is discussed. Surface wav solutions for the propagation of electromagnetic wave between inf. plane conductors are set up, and it is show that if one of the layers is of finite conductivity there is

ion which corresponds qualitatively with the observed ities and periods of the slow component. A.

MAGNETIC EFFECTS 538.6

514 : 538.224 : 541.64 : 541.24 *see Abstr.* 1353

)MIC AND MOLECULAR STRUCTURE 539

31 : 535.343.2 : 537.531 1284

ie energy levels of sodium chloride. FISHER, E. . *Rev.*, **73**, 36–40 (*Jan.* 1, 1948).—An energy-level me is given for the NaCl lattice. Its predictions are pared with numerous previous observations in the d-violet and X-ray regions and colour-centre nomena. A.

11 : 536.63 : 548.71 1285

ie specific heat of a linear ionic lattice. DONOVAN, B. . *Phys. Soc., Lond.*, **60**, 325–41 (*April*, 1948).—The cific heat at moderately high temperatures has been ulated for a one-dimensional lattice in which both trostatic and repulsive forces are taken into account. Thirring expansion method, which does not neces- te a knowledge of the density of normal vibrations of lattice, has been applied, and the resulting values of specific heat are compared with those obtained by phical integration of the frequency spectrum. rring's method involves expanding the specific heat a series in which the terms include summations over $2n$th powers of the normal frequencies. It is found values of $n > 4$ lead to computations which are essively laborious. Nevertheless, it is shown that able results may be obtained with 4 terms over a con- erable range of temperature. At lower temperatures Thirring method becomes progressively less accurate, owing that the number of terms used is insufficient, d a correction is derived from considerations of the mainder of the series after 4 terms. A.

9.13 : 533.7 1286

The influence of retardation on the London–van der aals forces. CASIMIR, H. B. G., AND POLDER, D. *ys. Rev.*, **73**, 360–72 (*Feb.* 15, 1948).—The influence of ardation on the energy of interaction between two utral atoms is investigated by means of quantum ctrodynamics. As a preliminary step, the interaction tween a neutral atom and a perfectly conducting plane discussed, and it is found that the influence of retarda- on leads to a reduction of the interaction energy by a rrection factor which decreases monotonically with creasing distance R. This factor $= 1$ for $R \ll$ the avelengths corresponding to the atomic frequencies, d $\propto 1/R$ for distances $\gg$ these wavelengths. In the tter case the total interaction energy $= -3\hbar c\alpha/8\pi R^4$, here α is the static polarizability of the atom. Although e problem of the interaction of two atoms is much ore difficult, the results are very similar. Again the fluence of retardation can be described by a mono- nically decreasing correction factor which $= 1$ for nall distances and $\propto 1/R$ for large distances. In the tter case the energy of interaction is found to be $-23\hbar c\alpha_1\alpha_2/4\pi R^7$. A.

39.13 : 548.75 : 535.51–15 : 535.343–15 *see Abstr.* 1202

39.132 1287

The force constants for CF_4 and C_2F_6. PACE, E. L. *Chem. Phys.*, **16**, 74–7 (*Jan.*, 1948).—Vibrational otential functions of the quadratic type for CF_4 and $_2F_6$, which assume no interaction between the CF_3 roups in C_2F_6 and include only the interaction terms volving bond-bending with bond-stretching motions, are used with the observed normal frequencies to evaluate a set of force constants for the molecules. The force constants associated with the CF_3 group are used interchangeably between the two molecules. The reproduction of the observed values of the normal frequencies resulting from the use of the force constants $\simeq 5\%$ or better except for three of the frequencies. The omission of terms in the potential function for the interaction of the CF_3 groups is largely responsible for the relatively poor reproduction of the type E_u frequencies of C_2F_6. Additional interaction terms, e.g. between bond-bending motions, are necessary for the improvement of the agreement in the case of the type F_2 frequencies of CF_4. A.

539.132 1288

An asymptotic expression for the energy levels of the rigid asymmetric rotor. GOLDEN, S. *J. Chem. Phys.*, **16**, 78–86 (*Jan.*, 1948).—The energy matrix evaluated in terms of symmetric rotor wave functions, has been examined under conditions where J is increased indefinitely. Asymptotically, the energy matrix assumes a form that is very much like the matrix that may be obtained from the characteristic value problem of Mathieu's differential equation. The characteristic values of Mathieu's equation serve as the basis for a good approximation to the energy values of those asymmetric rotor levels which, for a given, large value of J, correspond to a small value of K in the limiting symmetric cases. The differences which exist between the two matrices are accounted for by a perturbation technique which permits an accurate determination of the energy values. When the characteristic values of Mathieu's equation lead to a successful approximation to the energy values of the asymmetric rotor, an estimate may be made of the asymmetric rotor wave functions. A.

539.132 1289

Origin of the potential barrier hindering rotation in ethane and related substances. LASSETTRE, E. N., AND DEAN, L. B., JR. *J. Chem. Phys.*, **16**, 151–2 (*Feb.*, 1948).

539.132 1290

The triplet state of ethylene. CRAIG, D. P. *J. Chem. Phys.*, **16**, 158 (*Feb.*, 1948).

539.132 : 535.343 1291

Excited electronic levels in conjugated molecules. I. Long wavelength ultra-violet absorption of naphthalene, anthracene and homologs. COULSON, C. A. *Proc. Phys. Soc., Lond.*, **60**, 257–69 (1948).—The method of molecular orbitals has been applied to study the long wave ultra-violet absorption of the polyacene series, naphthalene, anthracene, etc. The longest wavelength in an allowed excitation probably arises from a transition between mobile electron levels of symmetry $A_{1g} \rightarrow B_{2u}$, and polarized across the width of the molecule. In the first four or five members of the series, the second wavelength is due to a transition $A_{1g} \rightarrow B_{1u}$, polarized along the length of the molecule. Discrepancies between this theory and both the valence-bond resonance treatment and the Lewis–Calvin theory of colour are elucidated. This assignment of transitions is in agreement with (*a*) calculation of absolute energies as a function of chain length; (*b*) calculation of relative energies of the B_{2u} and B_{1u} transitions; (*c*) limiting condition for a large number of rings; (*d*) calculations of intensities; and (*e*) some experimental work on fluorescence. A.

539.132 : 535.343 1292

Excited electronic levels in conjugated molecules. II. On the symmetry and multiplicity of molecular states. LONGUET-HIGGINS, H. C. *Proc. Phys. Soc., Lond.*, **60**,

270–81 (*March*, 1948).—A comparison of the valence-bond method and the method of molecular orbitals shows that the valence-bond method, while often more reliable for the calculation of ground-state energies, leads to erroneous conclusions as to the number and nature of the excited states, whereas the method of molecular orbitals gives the right number of excited states of any specified symmetry and multiplicity, and leads to semi-quantitatively correct energies for the ground state and lowest excited states. The latter method therefore seems to be the more reliable for the interpretation of electronic absorption spectra in conjugated systems. A.

539.132 : 535.343–15 1293

Intensities of vibration bands. I. Bending vibrations of benzene derivatives and the dipole of the C–H link. BELL, R. P., THOMPSON, H. W., AND VAGO, E. E. *Proc. Roy. Soc. A*, **192**, 498–507 (*March* 18, 1948).—A simplified potential energy function has been applied to calculate the frequencies and relative amplitudes of out-of-plane vibrations of benzene and its mono-, di- and tri-substituted derivatives. The frequencies and extinction coefficients of the infra-red absorption bands corresponding to the most intense mode of this class have been measured for 20 compounds in which the substituents were (CH_3) or a halogen. The observed and calculated frequencies show satisfactory agreement. The relative intensities calculated for the methyl derivatives are in accord with those predicted from the calculated amplitudes. By applying the same treatment to compounds containing one or more halogen substituents, an estimate has been made of the magnitude and direction of the dipole moment of the C–H link. It is shown unequivocally that the positive end of the dipole is the hydrogen atom, and the mean value is close to 0·42D. A.

539.132 : 535.343.4–14 1294

On the magnetic field of a rotating molecule. WICK, G. C. *Phys. Rev.*, **73**, 51–6 (*Jan.* 1, 1948).—The space distribution and magnitude of electronic currents in a rotating molecule with a $^1\Sigma$ ground state are re-examined. An evaluation of the magnetic field set up by the rotation is attempted, and the results are used to interpret the width of radio-frequency resonance lines of some alkali halides. A.

539.132 : 535.343.4–31 1295

Molecular orbital treatment of the ultraviolet spectra of benzene and borazole. ROOTHAAN, C. C. J., AND MULLIKEN, R. S. *J. Chem. Phys.*, **16**, 118–22 (*Feb.*, 1948).—The ground state and the first excited states of benzene and borazole are treated according to the semi-empirical molecular orbital method. Comparing the observed spectra with the computed energies, a spectroscopic value of $-2{\cdot}6$ eV for the bond integral β is obtained in the case of benzene. In the case of borazole this procedure includes one more parameter, which takes care of the difference in electronegativity of B and N. Taking a reasonable value for this parameter, a value of $-2{\cdot}3$ eV for the bond integral between B and N, β^*, is obtained in fair agreement with theoretical expectations. [See Abstr. 1205 (1948)]. A.

539.132 : 539.152.2 : 535.343.4–14 1296

Calculation of nuclear quadrupole effects in molecules. BARDEEN, J., AND TOWNES, C. H. *Phys. Rev.*, **73**, 97–105 (*Jan.* 15, 1948).—Methods are given for the computation of nuclear quadrupole interactions in molecules. They apply primarily to the interpretation of microwave spectra of linear and symmetric top molecules in which either one or two nuclei on the molecular axis show quadrupole coupling to the moelcular field. Tables are given of the energy values, based on Casimir's formula, for quadrupole coupling of a single nucleus, and also transformation coefficients for application to the case intermediate coupling when two nuclei are involv Spectral intensities are discussed briefly. Examples given to illustrate various aspects of the theory. molecules BrCN and ClCN show quadrupole effe resulting from the N nucleus as well as to the halog In the latter case, the intermediate coupling theory required for a complete explanation of the obser microwave-absorption lines, as there are signific deviations from the 1st-order linear approximation.

539.132 : 541.57 12

The electronic structure and bond lengths of corone and pyrene. MOFFITT, W. E., AND COULSON, C. *Proc. Phys. Soc., Lond.*, **60**, 309–15 (*April*, 1948). Molecular orbital and valence-bond pairing treatme are given for the bond lengths. In both cases the agr ment of the molecular orbital treatment with the expe mental values is good, and in both cases it is rath better than the agreement of the valence-bond metho though certain characteristic features are common both treatments and are found experimentally. The Fri rule, which governs the relative importance of the vario Kekulé structures in valence-bond theory, is shown to only partially applicable. A more valid rule is suggest for condensed hydrocarbons generally.

539.133 12

Note on volume effect in coiling molecules. SIMHA, *J. Res. Nat. Bur. Stand., Wash.*, **40**, 21–3 (*Jan.*, 1948). An estimate of the magnitude of the interference effe in a coil-like molecule is made by calculating the neares neighbour density w around a given link as a function the total number of contributing chain units. It is show for instance, that in a chain consisting of several hundre units, the first 15 contribute $\sim 75\%$ of the total neares neighbour density at distances $<$ the length of a linl The plots presented indicate that after $\sim$ the first 20 link the rate of increase of nearest-neighbour density begir to flatten off. It is also possible to derive the modificatio of the distribution function of chain-ends in real chain for a given form of w.

539.133 : 535.343.4–15 *see Abstr.* 1203–4

539.133 : 535.375.5 *see Abstr.* 1211

539.133 : 537.533.73 129

The molecular structure of dimethyltrisulfide, $(CH_3)_2S_3$ DONOHUE, J., AND SHOMAKER, V. *J. Chem. Phys.*, **16** 92–6 (*Feb.*, 1948).—$(CH_3)_2S_3$ has been investigated b the electron diffraction method. The molecule wa found to have the chain configuration, with the followin interatomic distances and angles: C–H = 1·09 (assumed), C–S = 1·78 ± 0·04 Å, S–S = 2·04 Å ± 0·02 Å, ∠H–C–S = 112° (assumed), ∠S–S–S = 104° ± 5°, and ∠C–S–S = 104° ± 5°. The results also suggest that the C–S bonds oscillate with rather large amplitude about a mean position approximately 106° out of the plane of the three S atoms. A.

539.15 130

An asymptotic solution of the fundamental equation of the statistical atom theory. HORVÁTH, J. I. *Nature, Lond.*, **161**, 27–8 (*Jan.* 3, 1948).

539.152.1 130

Nuclear models. SNEDDON, I. N., AND TOUSCHEK, B. F. *Nature, Lond.*, **161**, 61 (*Jan.* 10, 1948).—Some difficulties in Wilson's nuclear model [Abstr. 2359 (1946)] are pointed out; calculated spacing of energy levels do not agree with experiment, and the value of R_0 [radius = $R_0 \times (\text{mass number})^{\frac{1}{3}}$], calculated to be $1{\cdot}56 \times 10^{-13}$ cm

not agree with the value R_α derived from the many- theory of α-decay. An alternative model is pro- . in which equal numbers of protons and neutrons, ying equal volumes, are distributed as a central ical core of neutrons (R_0) surrounded by a shell of ns (R_α). $R_\alpha^3 = 2R_0^3$, thus $R_\alpha = 1{\cdot}97\times10^{-13}$, which se to Bethe's value [Abstr. 3308 (1937)].

52.1 : 537.533.74 1302

e charge distribution in nuclei and the scattering of energy electrons. Rose, M. E. *Phys. Rev.*, **73**, 4 (*Feb.* 15, 1948).—It is pointed out that the finite of the nucleus will give rise to large deviations from scattering when the change in wavelength of the ons $\simeq$ nuclear dimensions. This deviation at large ring angles therefore provides a possibility for mination of the shape of the charge distribution and of nuclei. In the case of a spherically symmetric e distribution the nuclear charge density is im- ately obtained from the observed angular distribution Fourier transform. The effects of competing pro- s, inelastic collisions with nuclear excitation or tegration, atomic excitation or ionization and sstrahlung are considered. It is shown that the first competing effects may be disregarded if the electron gy $\simeq$ 50 MeV, the angle of scattering large (but not π) and if the scattered electron has an energy = or e primary energy. With the latter condition fulfilled bremsstrahlung is reduced by the same factor as elastic scattering and the two processes are tinguishable. A.

52.2 : 535.343.4–14 : 539.132 *see Abstr.* 1296

52.2 : 538.222 *see Abstr.* 1275–7

53.4 : 535.331 1303

a the Rydberg–Ritz formula in quantum mechanics. row, R. *Phys. Rev.*, **73**, 60–7 (*Jan.* 1, 1948).— erivation is given of the Rydberg-Ritz formula for s spectra. Simple expressions are obtained for the ficients. It is shown that the Ritz coefficient $\propto$ the rence between the radial period of the electron and eriod of the hypothetical orbit, with the same energy h would exist if the atomic core were to contract to radius. The derivation necessitates a study of the luent hypergeometric function. An expansion in rs of the energy is obtained for this function. The ficients in the expansion are found to be simple com- tions of Bessel functions. Calculations of the berg and Ritz coefficients are carried out for the *S* s of Na, K and Cs and show satisfactory agreement observation. The comparison with experiment is information concerning the relative accuracy of rent types of central fields employed to approximate effect of the atomic core upon the valence electron. s concluded that the Hartree–Fock field is not a venient starting point for this purpose. A.

55.2 : 519.2 *see Abstr.* 1143

55.2 : 533.15 *see Abstr.* 1167

DIOACTIVITY . NUCLEAR DISINTEGRATION NUCLEAR PARTICLES 539.16/.18

16 : 532.772 *see Abstr.* 1166

.16.08 1304

he measurement of radioactivity in solution. Solomon, K., and Estes, H. D. *Rev. Sci. Instrum.*, **19**, 47–50 ., 1948).—The conditions have been examined and ommendations are given for optimum counting iency. The relative sensitivity of a dip counter has n found to compare favourably with other methods of counting, provided the β-radiation being measured has an energy of $\sim$ 1 MeV or higher. A.

539.16.08 : 621.318.57 : 537.591.08 *see Abstr.* 1266

539.163.1 1305

The half-life of carbon 14. Norris, L. D., and Inghram, M. G. *Phys. Rev.*, **73**, 350–60 (*Feb.* 15, 1948). —By determining the specific activities of two mass-spectroscopically analysed samples of $BaCO_3$ containing C^{14}, the $\frac{1}{2}$-life of the C^{14} was found to be $5\,100 \pm 200$ years. In order to determine the relative abundance of C^{12}, C^{13}, and C^{14}, the CO_2 was roasted from the $BaCO_3$ and introduced into the mass spectrometer. Weighed portions of the $BaCO_3$ were subsequently counted in a low absorption β-counter. Details of the analysis, weighing, and counting are given. A.

539.163.2 1306

Radiations from scandium^{46} and titanium^{51}. Mandeville, C. E., and Scherb, M. V. *Phys. Rev.*, 73, 141–5 (*Jan.* 15, 1948).—The characteristic radiations of these isotopes, prepared in a pile, have been investigated by absorption and coincidence methods. Sc^{46} was found to emit β-rays having a range of 0·076 g/cm² in Al and γ-rays having a max. energy of 1·0 MeV as determined by coincidence absorption. No hard β-rays having an end point near 1·5 MeV were observed to be emitted by Sc^{46}. The β-γ coincidence rate was found to be $1{\cdot}4\times10^{-3}$ coincidence per β-particle and independent of the β-ray energy, while the γ-γ coincidence rate was $(0{\cdot}62 \pm 0{\cdot}06)\times10^{-3}$ coincidence per γ-ray. These coincidence rates suggest that each β-ray is followed by two γ-rays. The 72-day isomer of Ti^{51} emitted β-rays having a range of 0·09 g/cm² in Al and γ-rays having a max. energy of 1·0 MeV by coincidence absorption. The β-γ coincidence rate was $0{\cdot}9\times10^{-3}$ coincidence per β-ray and was independent of the β-ray energy. The γ-γ coincidence rate was $(0{\cdot}35 \pm 0{\cdot}03)\times10^{-3}$ coincidence per γ-ray, These coincidence rates indicate that the β-transition leads to an excited state of the V^{51} residual nucleus and that some or all of the residual nuclei de-excite with the emission of two or more γ-rays in cascade. A.

539.163.2 1307

Radiations from tantalum (182), antimony (122), and indium (116). Mandeville, C. E., and Scherb, M. V. *Phys. Rev.*, **73**, 340–3 (*Feb.* 15, 1948).—The 100-day activity was induced in Ta irradiated by slow neutrons in the Clinton pile. The β-rays were found to have a range in Al of 0·112 g/cm², and the γ-rays a max. energy of $1{\cdot}16 \pm 0{\cdot}1$ MeV as determined by coincidence absorption. The β-γ coincidence rate was $0{\cdot}93\times10^{-3}$ per β-ray, independent of β-ray energy, and a γ-γ rate of $(0{\cdot}27 \pm 0{\cdot}03)\times10^{-3}$ per γ-ray was obtained. These data indicate that β-emission by Ta^{182} leads to an excited state of W^{182} and that de-excitation occurs with the emission of two or more γ-rays in cascade. The 2·8-day activity of Sb^{122} was also prepared in the pile. The β-γ coincidence rate was found to drop to zero at 0·487 g/cm² in Al, corresponding to 1·19 MeV. The maximum energy of the β-rays was measured to be 1·77 MeV. The β-γ coincidence rate of the 54-min isomer of In^{116} was found to be $1{\cdot}3\times10^{-3}$ per β-ray independent of β-ray energy, and a γ-γ rate of $(0{\cdot}9 \pm 0{\cdot}1)\times10^{-3}$ per γ-ray was also observed. A disintegration scheme is given for Sb^{122}. A.

539.163.2 : 539.166 1308

The absorption of Na^{24} gamma-radiation in lead, copper, and aluminum. Alburger, D. E. *Phys. Rev.*, **73**, 344–6 (*Feb.* 15, 1948).—The absorption was measured with a Geiger–Müller counter out to 16 cm of Pb, 22 cm

of Cu, and 61·5 cm of Al. Each of the curves obtained can be analysed into two components, with absorption coefficients $0{\cdot}454 \pm 0{\cdot}004$ and $0{\cdot}62 \pm 0{\cdot}01$ cm^{-1} for Pb, $0{\cdot}311 \pm 0{\cdot}005$ and $0{\cdot}46 \pm 0{\cdot}01$ cm^{-1} for Cu, and $0{\cdot}088 \pm 0{\cdot}001$ and $0{\cdot}144 \pm 0{\cdot}005$ cm^{-1} for Al. All of these agree with theoretical values obtained from Heitler's curves for the Na γ-rays of energies 2·76 and 1·38 MeV, respectively. A.

539.164.08 : 535.376 1309

Photoelectric alpha-particle detector. CURRAN, S. C., AND BAKER, W. R. *Rev. Sci. Instrum.*, **19**, 116 (*Feb.*, 1948).—A multiplier photo-electric tube used to count the scintillations from a Ag-sensitized ZnS luminescent screen was found to be 80–100% efficient. The average value of the output pulse was 6 V, about 3 × peak noise level. Background, 0·5 pulse/min. The apparatus is simple, robust and free from microphony.

539.164.08 : 537.542 1310

Factors affecting operation of apparatus for counting alpha particles in an ion counting chamber. DAVIS, F. J. *J. Res. Nat. Bur. Stand., Wash.*, **39**, 545–50 (*Dec.*, 1947).—The resolving time of two amplifier circuits is discussed. The original circuit, using a floating grid on the first stage of the amplifier, gave a resolving time of $2{\cdot}5 \times 10^{-3}$ sec. An improved circuit using a 1 MΩ grid resistor on the first stage lowered the resolving time to $1{\cdot}4 \times 10^{-4}$ sec. The effect on the counting rate of the presence of small amounts of CO, CO_2, H_2O and HCl in the ion chamber was found to be negligible. The presence of 1% of air, however, reduces the counting efficiency by 20%. A method whereby the collection time of Rd in Ra solutions may be of the order of ½ hour is given. Experiments show that boiling and bubbling N_2 through 200 ml Ra solutions for 17 min removes 99·99% of the Rd. The absorption of Rd by small neoprene meteorological balloons was found to be $\sim 0{\cdot}03\%$ min/100 cm². A.

539.165.1 1311

The limits of beta-stability. KOHMAN, T. P. *Phys. Rev.*, **73**, 16–21 (*Jan.* 1, 1948).—The β-stable nuclides are plotted in such a manner as to indicate the charge of maximum stability for odd mass numbers and the upper and lower limits of β-stability for even mass and charge numbers. Curves representing these three quantities are drawn in following considerations based on the liquid-drop nuclear model, by which their positions can be determined fairly closely. The spacing between the curves is related to the parameters of the empirical mass equation of Bohr and Wheeler. The diagram is used to indicate the possibility of undetected natural radio-activities, and to suggest possible undiscovered or "missing" β-stable nuclides. A.

539.165.2 1312

Momentum conservation in the beta-decay of P^{32} and the angular correlation of neutrinos with electrons. SHERWIN, C. W. *Phys. Rev.*, **73**, 216–25 (*Feb.* 1, 1948).—It is possible, by evaporation of carrier-free P^{32}, to produce what appear to be monolayer β-active sources. The momentum of the recoil ion was measured by timing its flight in a field-free space. Recoil momentum spectra were observed at 180°, 135°, 90°, and 45° with respect to the electrons. It is shown that (*a*) momentum is not conserved between the electron and the recoil nucleus, (*b*) the experimental data are in disagreement with any hypothesis in which the neutrino and the electron are most probably emitted in the same hemisphere, (*c*) for recoil ions above ~ 25 eV energy, the observed recoil momentum spectra agree rather well with those spectra calculated on the assumption of a $(1 - \beta \cos\theta)$ neutrino-electron angular correlation function, and (*d*) below 25 eV too many recoils are observed compared to neutrino theory which gives agreement for high mom tum recoils. Since the reason for the disagreement be 25 eV is not understood, the selection of the $(1 - \beta co$ function must be regarded as tentative.

539.166 : 539.163.2 *see Abstr.* 1308

539.166 : 539.172 *see Abstr.* 1314

539.166 : 539.185 : 539.172.1 *see Abstr.* 1318

539.166.08 : 578.088.5 1

***In vivo* Geiger–Müller gamma-ray counter for ra isotope distribution studies.** PACE, N., LOEVINGER, AND STRAJMAN, E. *Science*, **107**, 71–3 (*Jan.* 16, 1948)

539.167.3 : 541.183 *see Abstr.* 1347

539.172 : 539.166 1

Proton-gamma-ray coincidence counting with cyclot bombardment. BENSON, B. B *Phys. Rev.*, **73**, 7–15 (J 1, 1948).—A technique is given for studying associati between protons and γ-rays emitted when a targe bombarded with particles from the cyclotron. A desc tion is included of the theoretical considerations invol and of the apparatus developed. The results on $Al^{27}(\alpha, p)Si^{30}$ reaction indicate that no γ-rays accomp the end group of protons, while other groups exh coincidences. The coincidence rate increases w excitation energy. This may be due to cascade transiti giving more quanta, or to increased sensitivity for hig energy quanta. The fourth group observed with ze degree bombardment is shown to be a composite knock-on protons and protons from the reaction. brief proton group study is included, with *Q*-values essential agreement with previous work.

539.172.1 1

Angular distribution of the (*d*,*p*) reactions making low states of O^{17}. HEYDENBURG, N. P., AND ING D. R. *Phys. Rev.*, **73**, 230–40 (*Feb.* 1, 1948).—Angu distributions of the protons from deuteron bombardm of fairly thin oxide targets have been observed both the long-range protons leading to the ground state the residual nucleus O^{17}, and for the short-range prot leading to the first excited state. The deuteron energ ranged from 0·65 to 3·05 MeV, and the beam practically mono-energetic. The yield of the short-ra is $\sim 10\times$ that of the long-range protons at low bomba ing energies, and the two yields become nearly equal higher energies. Very pronounced variation of prot intensity with angle was observed for both ranges almost all bombarding energies, the shape of the cur varying markedly with energy. At low bombard energies the long-range protons are predominar forward, the short-range predominantly backward. the neighbourhood of a peak in the excitation curves about 1·8 MeV, the angular distributions become roug symmetric about 90° for both ranges, and even alm isotropic for the long-range protons. It happens that high energy side of this peak coincides rather closely w the threshold of the competing (*d*,*n*) reaction. This p appears for both ranges in the excitation curves for total yield, integrated over all angles, but not in conventional 90° excitation curves. Two further pe appear at higher energies. It is hoped that relationsh between the angular momentum properties of the t low states of the final nucleus may be deduced fr detailed angular information of the sort here presented.

539.172.1 1

Angular distribution from $Li^7(p, \alpha)\alpha$. HEYDENBU N. P., HUDSON, C. M., INGLIS, D. R., AND WHITEHE W. D., JR. *Phys. Rev.*, **73**, 241–5 (*Feb.* 1, 1948).—T

ar distribution of α-particles has been measured at n energies of 1–3 MeV. The yield as a function of in the centre-of-mass system follows the form $= Y(90°) \times (1 + A\cos^2\theta + B\cos^4\theta)$, where the term $s^4\theta$ is clearly present. The value of A shows a ance peak at ~ 1 MeV and declines to a low value MeV. Values of B calculated from the data range $-0{\cdot}1$ to $-1{\cdot}2$ but are not sufficiently well ed to determine their dependence upon bombarding y. A.

72.1 : 539.185 1317

e (H^3, p) reaction in Rh and Co and probable evidence e di-neutron. KUNDU, D. N., AND POOL, M. L. *Rev.*, **73**, 22–6 (*Jan.* 1, 1948).—By H^3 bombard-, two neutrons have been introduced into Rh and uclei according to reactions $Rh^{103}(H^3, p)Rh^{105}$ and $H^3, p)Co^{61}$, with ½-lives of 35 and 1·75 hr, re-ively. The mechanism appears to be an Oppen-er–Phillips process with H^3. The results are inter-d in the light of the di-neutron ($_0n^2$). It is believed $_0n^2$ may exist under the physical conditions of the riments reported. A.

172.1 : 539.185 : 539.166 1318

eutron and gamma-ray yields from deuterons on on. BAILEY, C. L., FREIER, G., AND WILLIAMS, J. H. *Rev.*, **73**, 274–8 (*Feb.* 15, 1948).—Observations from mbarded with deuterons of discrete energies between and 3·25 MeV are reported. The yield of neutrons unit solid angle at 0° and 90° is given in absolute s. Resonances for the formation of the compound eus N^{14} exhibit features such as: varied widths of nances, shifts in energy between γ-ray and neutron nances, exclusion of neutron resonances by γ-ray nances and *vice versa*, and the strong forward ametry of the neutron yield. A.

172.4 : 539.185 1319

elayed neutrons from fission of U^{235}. HUGHES, D. J., BS, J., CAHN, A., AND HALL, D. *Phys. Rev.*, **73**, 24 (*Jan.* 15, 1948).—The periods, yields and energies, sured with a pneumatic transfer apparatus on a heavy r pile, are given. Periods > 0·02 sec after irradia-were measured, and range from 0·05 to 55·6 sec e; energies, 250 to 620 kV; total yield, 0·755%. The fication of the data to the constants of pile kinetics is ussed, and the value of the *inhour* (pile reactivity) is calculated. A.

172.4 : 539.185.7 1320

determination of the $S^{32}(n, p)P^{32}$ cross section for trons having energies of 1·6 to 5·8 Mev. KLEMA, D., AND HANSON, A. O. *Phys. Rev.*, **73**, 106–10 (*Jan.* 1948).—S was irradiated with known fluxes of mono-rgetic neutrons having energies of 1·6 to 5·8 MeV. formation of P^{32} by the $S^{32}(n,p)P^{32}$ reaction was ected by means of the P^{32} β-activity. The cross-section the reaction at the lower neutron energies has the e form as the penetrability of the protons from the tion through the Coulomb barrier. At the higher rgies the cross-section for the reaction reaches an roximately constant value of $0{\cdot}3 \times 10^{-24}$ cm². A.

.18 : 537.591.15 : 530.145 *see Abstr.* 1152

.185 1321

The polarizability of the neutron in an electrostatic field. TSON, K. M. *Phys. Rev.*, **73**, 125–6 (*Jan.* 15, 1948).—an applied electrostatic field the meson-charge cloud out a neutron should become polarized. The dipole ment for a neutron in an electrostatic field E is $e^2/\mu^3)E$. This should give rise to an attractive force ween a neutron and a charged particle. A.

539.185 1322

The scattering of high energy neutrons by protons. CAMAC, M., AND BETHE, H. A. *Phys. Rev.*, **73**, 191–6 (*Feb.* 1, 1948).—The scattering has been calculated, using the exact formula, for neutron energies between 20 and 80 MeV, with ranges of $2{\cdot}0$ and $2{\cdot}8 \times 10^{-13}$ cm for the nuclear force and using ordinary, exchange, and symmetric forces. The maximum of the scattered intensity at 180° is sensitive to the range of the forces; experiments with neutrons from 30 to 60 MeV would permit a rather conclusive determination of the range. The total cross-section for forces of the exchange type ⩽ that obtained from the Born approximation, even at 80 MeV. A.

539.185 1323

The scattering of neutrons of energy between 12·0 Mev and 13·0 Mev by protons. LAUGHLIN, J. S., AND KRUGER, P. G. *Phys. Rev.*, **73**, 197–207 (*Feb.* 1, 1948).—The angular distribution of the recoil protons projected during the scattering of neutrons by protons has been investigated in a methane-filled, high-pressure cloud chamber. A deuterium gas target bombarded with 10-MeV deuterons provided the high energy neutron source. The spectrum of the neutrons from this source, which entered the cloud chamber through a collimator, was surveyed showing a group of high energy neutrons superimposed on a continuous background. Examination of the data with rigorous selection criteria to determine those recoils projected by the scattering of neutrons between 12 and 13 MeV yielded a total of 1 573 recoil protons. The azimuthal and recoil angle distributions of these protons have been analysed. A ratio of the differential cross-sections for neutron scattering in the backward direction to scattering in a direction perpendicular to that of the incident neutron beam, of unity (spherically symmetric scattering) or slightly > unity can be consistent with these data. A.

539.185 1324

Range of Ra — α — Be neutrons in water. RUSH, J. H. *Phys. Rev.*, **73**, 271–3 (*Feb.* 15, 1948).—Radial distributions of Ra — α — Be neutrons about an approximate point source in water were determined by means of In foil activations. Values for migration area (M^2) derived from the data are: For all activating neutrons, 54·7 cm²; for In resonance neutrons, 45·4 cm². A.

539.185 : 530.14 1325

Scattering of D–D neutrons by deuterium. DARBY, J. F., AND SWAN, J. B. *Nature, Lond.*, **161**, 22–3 (*Jan.* 3, 1948).—The tracks of 1 500 recoils from D–D neutrons of 2·53-MeV energy were photographed in a cloud chamber filled with CD_4. Statistical analysis of the angular distribution gives results which lie closer to the curve for ordinary neutron-deuteron forces than to that for exchange forces [see Abstr. 1727 (1947)].

539.185 : 539.166 : 539.172.1 *see Abstr.* 1318

539.185 : 539.172.1 *see Abstr.* 1317

539.185 : 539.172.4 *see Abstr.* 1319

539.185.7 : 539.172.4 *see Abstr.* 1320

STRUCTURE OF SOLIDS 539.2

539.213 : 536.41 : 666 1326

Expansion effects shown by some Pyrex glasses. TOOL, A. Q., AND SAUNDERS, J. B. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 67–83 (*Jan.*, 1948).—Thermal expansion data are presented, which apparently confirm a previously expressed belief that some of the borosilicate glasses containing a high percentage of silica are essentially 2-component glasses. One of these components is

presumably composed almost entirely of silica and forms into a comparatively rigid and continuous spatial network that pervades the whole glass. This formation develops before the glass is cooled into the annealing range of the other component which is composed of a portion of the silica and most of the other constituents. On being cooled into its annealing range and particularly on reaching temperatures below this range, the low-temperature component also forms a fairly rigid network which is interlaced with that of the high-temperature component. The latter, being composed mainly of silica, possesses a considerably lower expansivity than the other. Consequently, the low-temperature component, whenever it behaves as a rigid network, elastically compresses the other component on cooling and is, in turn, elastically distended. Annealing the glass at suitable temperatures relaxes the compressions and distensions. Such relaxations cause expansions and contractions that are unlike those found in a normal single-component glass. As a result, thermal expansion cycles obtained on glasses containing a high percentage of silica show certain peculiarities. Several cases in which these appear are presented and discussed. A.

539.216 : 539.26 1327

X-ray study of vegetable fibres. BANERJEE, B. K. *Indian J. Phys.*, **21**, 259–66 (*Dec.*, 1947).—Some vegetable fibres have been studied by means of X-rays and it was found that the orientation of cellulose crystallites was not the same in all cases. In some the major axis of the unit cell was almost parallel to the fibre axis and in others the major axis was at some spiral angle to the fibre axis; while in an extreme case the cellulose crystallites were randomly distributed. A.

539.216.1 : 541.183 *see Abstr.* 1348

539.217 1328

Self-diffusion in iron. BIRCHENALL, C. E., AND MEHL, R. F. *J. Appl. Phys.*, **19**, 217–18 (*Feb.*, 1948).—Measurements were made on α- and γ-Fe over a range of temperatures, using radioactive Fe. At the transition point, the rate in α is about 100× the value in γ. Empirical expressions for the temp.-variation of the rates are given. Large differences were observed between the activation energies in the two phases, and the Dushman–Langmuir equation is found to be inconsistent with the results.

539.217 1329

An experimental and theoretical investigation of diffusion in a two-phase alloy. DANIEL, V. *Proc. Roy. Soc. A*, **192**, 575–92 (*March* 18, 1948).—Previous experimental work has been confined to the case in which the free energy of a mixture is a minimum for the single-phase state, and diffusion decreases local differences of concentration. This may be called "diffusion downhill." However, it is possible for the free energy to be a minimum for the 2-phase state; diffusion may then increase differences of concentration; and so may be called "diffusion uphill." The present paper describes an experimental test of Becker's theory of these two types of diffusion, using the unusual properties of the alloy Cu_4FeNi_3. This alloy is single-phase above 800°C and 2-phase at lower temperatures, both the phases being face-centred cubic; the essential difference is their content of Cu. On dissociating from one phase into two, the alloy develops a series of intermediate structures showing striking X-ray patterns which are very sensitive to changes of structure. It was found possible to utilize these results for a quantitative study of diffusion "uphill" and "downhill" in the alloy. The results are in fair agreement with Becker's theory. It was found that Fick's equation, $\partial c/\partial t = D\partial^2 c/\partial x^2$, can, within the limits of error, be applied in all cases, with the modif tion that c denotes the difference of the measured concentration from its equilibrium value. The the postulates that D is the product of two factors, of wh one is D_0, the coefficient of diffusion that would measured if the alloy were an ideal solid solution. theory permits calculation of D/D_0, if only in first appr mation, and the experiments confirm this calculati It was found that in most cases the speed of diffusio "uphill" or "downhill"—has the order of magnitud D_0.

539.217.1 : 534.6 *see Abstr.* 1186

539.217.1 : 541.183 : 533.15 *see Abstr.* 1168

539.219.2 : 621.357.7 : 539.232 *see Abstr.* 1331

539.23 : 537.226 : 537.529 *see Abstr.* 1252

539.23 : 537.311.33 : 537.311.4 *see Abstr.* 1242

539.232 1

The theory of the formation of protective oxide films metals. III. MOTT, N. F. *Trans. Faraday Soc.*, 429–34 (*July*, 1947).—A new mechanism is proposed account for the formation on metals of oxide films wh grow to a limiting thickness. According to this, electr can pass the film easily, but ions can only penetrate i the presence of a very strong field. This mechanism compared with the author's previous theory based tunnel effect; further experimental work is required determine which is correct.

539.232 : 539.219.2 : 621.357.7 1

The influence of internal stress on the structure electro-deposits. WYLLIE, M. R. J. *J. Chem. Phys.*, 52–64 (*Jan.*, 1948).—It is shown that the author's d [Abstr. 2089 (1944), 207 B (1948)] on the properties Cr electro-deposited from a standard chromic a electrolyte fit well the assumption that the prefer orientation is the result of a slipping process, analog to cold-working, which occurs during deposition w internal contractile stress reaches a certain critical val It is further shown that the type of orientation is accord with theory [Abstr. 37 (1926)], and it is sta that (111) orientation is to be expected generally body-centred cubic metals electro-deposited in state contractile stress, while (110) or (100) is to be anticipa for face-centred cubic metals deposited with the sa type of stress. The orientations of a number of elect deposited metals are shown to be in agreement with expectation. Certain anomalies in the stress and orien tion results for Ag, Ni, and Al deposits have also b studied experimentally, and the results explained. conclusion, the possible mechanism of internal str formation in electro-deposits is examined.

539.232 : 621.357.7 1

Physical properties of electrodeposited chromi BRENNER, A., BURKHEAD, P., AND JENNINGS, C. *J. Nat. Bur. Stand., Wash.*, **40**, 31–59 (*Jan.*, 1948).— following properties of Cr, deposited under a w variety of plating conditions, have been measur density, hardness, tensile strength, Young's modulus elasticity, ductility, electrical resistivity, and stress in deposit. The O and H content were determined. effect of heat treatments up to 1 200°C on certain of th properties has been determined, and some work has b done on the properties of Cr–Fe alloys deposited fr modified chromic acid solutions. A relation between H and O content of the deposits has been shown to ex and the effect of the O content on the physical proper has been studied.

539.234 : 539.264 *see Abstr.* 1333

26 : 539.216 *see Abstr.* 1327

26 : 545.824 : 548.73 *see Abstr.* 1361

264 : 539.234 1333

nall-angle X-ray scattering from metal deposits made vaporation. CARROLL, B., AND FANKUCHEN, I. *J. m. Phys.*, **16**, 153–4 (*Feb.*, 1948).—"Black" deposits Al and Cu formed by evaporation at pressures of ¹ and 10^{-4} mm were examined by Debye–Scherrer small-angle diagrams, and compared with bright osits nearer the source. The latter showed sub-tially similar Debye–Scherrer diagrams, but no small-e scattering, whereas the former did. Average icle size of Al and Cu black was 110 Å and 90 Å, ectively; the bright deposits had crystals $\sim 10^{-5}$ cm.

ASTICITY . STRENGTH . RHEOLOGY 539.3/.8

31 : 536.7 1334

he thermodynamics of irreversible processes. IV. theory of elasticity and anelasticity. ECKART, C. *s. Rev.*, **73**, 373–82 (*Feb.* 15, 1948).—A classical theory nelasticity is outlined, after removing two traditional assumptions: the principle of a constant relaxed standard) state; and the principle of macro-relaxibility, ch is replaced by micro-relaxibility, analogous to mann differential geometry. It is first shown that the ability of the relaxed state makes the density of the stance independent of the strains. Consequently, the rnal energy can depend on the specific volume as well n the strains and the entropy. The expression for the of increase of entropy is then derived. As usual, this gests, but does not uniquely determine the form of the ipative laws. In addition to the usual equations for viscous stresses, one is led to another set of equations olving parameters that quantitatively describe the lastic properties of the substance. These results are d to derive the equations for the waves of distortion dilation in an ideal isotropic anelastic medium. en the two coefficients of viscosity and two coefficients anelasticity all vanish, these reduce to the usual lations for such waves. In addition to the 4 dis-tive coefficients, the isotropic anelastic substance is racterized by 4 elastic moduli, rather than by the 2 t characterize an isotropic elastic substance. Thus, re are 8 parameters whose values can be adjusted to cribe the particular substance. When the 4 dissipative ameters do not vanish, the propagation of the waves be described by 5 relaxation times. The ideal tropic anelastic substance thus has a relaxation ctrum of about the same complexity as those of actual stances. The kinematic independence of the density d the strains causes a hydrostatic pressure to have ferent dynamic effects from a uniaxial pressure. This n accord with experiment—the latter being much more ctive in producing anelastic deformation than the mer. A.

.319 : 537.531 1335

Measurement of stress by means of X-rays. THOMAS, E. *J. Appl. Phys.*, **19**, 190–3 (*Feb.*, 1948).—The article ows how the formulae used in stress measurement by rays are derived and points out an error in a recently blished book. A.

.32 1336

Tensile properties of rolled silver chloride. AXILROD, M., AND LAMB, J. J. *J. Appl. Phys.*, **19**, 213–16 (*Feb.*, 48).—Tensile tests were made at 25° and 93°C on ecimens taken from a rolled AgCl sheet prepared from single crystal. Tensile strengths of ~2 500 and 1 500 lb/in² were obtained at 25° and 93°C, respectively; the corresponding elongations at failure were ~ 15 and 40%, respectively. For specimens annealed at 200°C and tested at 25°C, the tensile strength was 75% and the elongation about twice that of the corresponding values for unannealed specimens. The stress-strain diagram of the rolled material was determined at 25°C with optical strain gauges while loading and unloading two specimens to maximum strains of 0·0015 and 0·0037, respectively; no effect of this moderate strain on the infra-red transmissivity was observed. A.

539.37.08 : 531.222 *see Abstr.* 1153

539.374 1337

Thermally reversible strains in plasticized polyvinyl chloride. POLLETT, W. F. O. *J. Soc. Chem. Ind.*, **66**, 319–23 (*Sept.*, 1947).—Torsion tests have been used to investigate the strain in relation to the conditions under which it is produced. The initial set, on cooling after release of the applied strain, increases with the time, temperature and extent of deformation and rapidity of cooling, but under the experimental conditions was almost wholly recoverable on re-heating. Cooling under strain increases the initial set, and recovery then begins at the commencement of re-heating; otherwise it starts at a higher temperature the slower the cooling after release. Recovery per unit temperature rise reaches a maximum just below the straining temperature, at a position depending on straining time and rate of cooling, but not on composition within wide limits. Even opposed strains introduced successively at diminishing temperatures are separately recoverable on re-heating. A qualitative explanation of the phenomena is proposed which assumes the presence of associations covering a wide range of stabilities. A.

539.374 1338

On the inhomogeneity of plastic deformation in the crystals of an aggregate. BOAS, W., AND HARGREAVES, M. E. *Proc. Roy. Soc. A*, **193**, 89–97 (*April* 22, 1948).—The variation of plastic deformation in Al specimens consisting of large crystals has been determined by measuring elongation and hardness at various points after tensile deformation. The deformation varied from grain to grain, and also within each grain the deformation near the boundary was $>$ or $<$ at the centre according to whether the neighbour was more or less deformed, i.e. there is not necessarily inhibition of slip near grain boundaries. These results were supported by metallographic and X-ray observations. Their importance with respect to the calculation of the stress-strain curve of aggregates from those of single crystals is discussed. It is suggested that a mechanism other than slip operates near the grain boundaries during deformation, and even within the crystals during large extensions. A.

539.374 : 531.259.2 1339

Partially plastic thick-walled tubes. MACGREGOR, C. W., COFFIN, L. F., JR., AND FISHER, J. C. *J. Franklin Inst.*, **245**, 135–58 (*Feb.*, 1948).—A theory is presented for the partial plastic yielding of thick-walled cylindrical tubes acted upon by any combination of internal pressure, external pressure and end load when the material follows an arbitrary stress-strain law. The solution combines (*a*) the distortion energy theory of plastic flow and (*b*) the effects of elastic compressibility of the plastic material. Numerical values for stresses and strains are given for certain special cases of internal pressure in thick-walled open-ended tubes for an idealized stress-strain law, and the results are compared with earlier approximate theories. A.

539.42 1340

A statistical analysis of some mechanical properties of manila rope. NEWMAN, S. B., AND CURTISS, J. H. *J. Res. Nat. Bur. Stand., Wash.*, **39**, 551–9 (*Dec.*, 1947).—Breaking strength, weight, and circumference are three important qualities that are determined when ropes are submitted for test. These properties are all subject to some variation because of differences in fibre quality, method of fabrication, and previous treatment. The results of tests on more than 800 samples of 3-strand manila ropes ranging in size from $\frac{3}{16}$ in. to 3 in. in diameter are tabulated and analysed by the methods of modern mathematical statistics. Considerable emphasis is placed on the rationale and details of the methods of analysis, as they are considered to be applicable to a broad variety of similar projects. A.

539.42 : 519.21 1341

Statistical aspects of fracture problems. EPSTEIN, B. *J. Appl. Phys.*, **19**, 140–7 (*Feb.*, 1948).—A main aim of statistical theories of strength is to explain in a reasonable way such things as the dependence of the strength of specimens on their volume or length. It is pointed out that the problems posed by these models are equivalent to an important problem in mathematical statistics, namely, the distribution of the smallest value in samples of size n drawn from a population having some probability density function $f(x)$. A.

539.431 : 666 1342

Fatigue of mineral glass under static and cyclic loading. GURNEY, C., AND PEARSON, S. *Proc. Roy. Soc. A*, **192**, 537–44 (*March* 18, 1948).—Round soda-glass rods were broken in 4-point bending. In one series of experiments, the load was increased at a constant rate until fracture occurred, and in another series, the times to fracture under a range of constant loads were determined. Tests in each series were made under three different test conditions—non-rotating, rotating at 14 and at 10 000 r.p.m. It is concluded from the experiments that glass does not fatigue under cyclic loading appreciably faster than it does under static loading. This was in accord w expectations, if the static fatigue of glass is due to t spread of cracks rather than to deterioration of t inherent strength of flawless material. As fracture glass under static conditions is not preceded by flow a work hardening as it is for metals, the difference fatigue behaviour of glass and metals is an indir indication that the fatigue of metals is associated w flow and work hardening, and thus agrees with mc direct evidence on the nature of fatigue in metals.

539.61 13

An improved tackiness meter. LAMBERT, J. M., A McDONALD, R. A. *Rev. Sci. Instrum.*, **19**, 119– (*Feb.*, 1948).

539.62 : 541.183 : 532.516 13

Graphite lubrication. SAVAGE, R. H. *J. Appl. Phy* **19**, 1–10 (*Jan.*, 1948).—The slipperiness of graphite is n inherent in the crystal structure alone but depends up adsorption films, especially water, which cover the carb atoms and provide surfaces of low cohesion. In vacuu graphite rods or brushes seize upon a moving ba (copper or graphite) and wear away as a fine du This wear and accompanying high friction are instant stopped by some condensible vapours at low pressur (H_2O, C_6H_6, NH_3, etc.) which apparently effect t coverage of the graphite by a reversible adsorpti governed by the pressure and surface temperatu Under conditions of optimum coverage (zero wear) t graphite friction is still appreciable but may be account for as the heat of cohesion of water monolayers attach to the C atoms and undergoing successive makes-an breaks. From the measured frictional energy and assigned heat of cohesion based upon surface ener data, the area of molecular contact is estimated to 4×10^{-6} cm² under a real pressure 2×10^{4} kg/cm². Ti wear dust of unlubricated graphite shows a uniq adsorptive power at room temperature, greater for than that of activated charcoal by 5 orders of magnitud

PHYSICAL CHEMISTRY 541

REACTION KINETICS 541.124/.128

541.126 : 536.71 : 533.75 *see Abstr.* 1176

541.127.1 1345

Discussion of the absolute reaction rate of unimolecular decompositions. HIRSCHFELDER, J. O. *J. Chem. Phys.*, **16**, 22–5 (*Jan.*, 1948).—In the usual theory of absolute reaction rates it is assumed that the molecules in the activated complex are in statistical equilibrium with the molecules in the initial state. This assumption is not justified in the case of unimolecular decompositions because the molecules in the initial state must gain the energy of activation by a stepwise process, usually by the transfer of quanta of vibrational energy from one normal mode to another. The size of these energy jumps and their frequency inevitably affect the over-all reaction rate. The problem is considered in considerable detail for a rough idealized mode. In this case, the actual reaction rate should be smaller by a factor of 0·5 to 0·387 than the value computed from the usual theory of absolute rates. A rigorous development would require further development of the original Ramsperger–Rice–Kassel treatment. A.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18.56 : 536.7 1346

Statistical thermodynamics of the sorption of vapors by solids. DOLE, M. *J. Chem. Phys.*, **16**, 25–30 (*Jan.*, 1948).—The statistical method of treating the sorption vapours, begun by Fowler and Guggenheim and extend to multilayer sorption by Cassie and Hill, is furth generalized to include variable heats of sorption different layers. It is shown under what conditions mult layer sorption can lead to a linear isotherm and to variou modifications of the Brunauer–Emmett–Teller equatio The treatment is also extended to the case of interactic between sorbed molecules in the same layer.

541.182.2 : 532.525 *see Abstr.* 1162

541.182.62 : 537.363 *see Abstr.* 1245

ADSORPTION 541.183

541.183 : 532.516 : 539.62 *see Abstr.* 1344

541.183 : 532.612.4 *see Abstr.* 1165

541.183 : 539.167.3 134

Target chemistry of cesium; isolation of Ba$^{133, 13}$. KURBATOV, M. H., YU, F. C., AND KURBATOV, J. H. *J. Chem. Phys.*, **16**, 87–91 (*Feb.*, 1948).—Ba$^{133, 1}$ obtained by (d,n) and $(d,2n)$ reactions of spectroscopicall pure CsCl was separated in quantities of $< 1\times10^{-9}$ without addition of common Ba. The procedure studie involves adsorption of Ba on hydrous ferric oxide unde conditions at which Cs ions remain in solution. Th effect of (*a*) *p*H of solution, and (*b*) varying quantities hydrous ferric oxide on the fraction of Ba adsorbed fro

ion containing $< 10^{-9}$ g Ba, keeping other factors tant, showed that the fraction of Ba adsorbed, $k[Z(X - X_0)]^\lambda$, Z being the quantity of adsorbent n 1×10^{-5} to 3×10^{-4} g atom Fe); X, the OH^- entration in solution (from 3×10^{-9} to 3×10^{-6}); X_0, critical concentration of OH^- necessary to maintain adsorbent in the solid state. When pH was kept tant the value of λ for $y = k'Z^\lambda$ was found to be , and when the quantity of adsorbent was constant for $y = k''(X - X_0)^\lambda$ was 0·33. The fact that the experimental slopes were so nearly the same in spite rtain variations in experimental conditions is taken apport for two assumptions made in the derivation e expression, namely (1) the fraction of Ba adsorbed a very dilute solution depends on the quantity of rptive centres in the solid phase and (2) the quantity dsorptive centres in the solid phase available for Ba rption $\propto$ the OH^- concentration in solution, other rs being constant. Adsorption procedure is ribed. A.

183 : 539.216.1 1348

rption of nitrogen and water vapor on textile fibers. EN, J. W., AND BLAINE, R. L. *J. Res. Nat. Bur. d., Wash.*, **39**, 479–86 (*Dec.*, 1947).—Measurements made on 6 purified textile fibres and TiO_2. It was d that all the fibres had a relatively low capacity for adsorption of N as compared with adsorption of vapour. The surface area values ranged from m^2/g for nylon to 0·98 viscose rayon. The values ne free surface energies of adsorption as calculated ne Gibbs adsorption equation were the same for wool, on, silk, and rayon fibres but differed for the two hetic polymers, nylon and acetate rayon. A.

183 : 539.217.1 : 533.15 *see Abstr.* 1168

183.5 1349

heory of chromatography. II. Chromatograms of a le solute. GLUECKAUF, E. *J. Chem. Soc.*, 1302–8 ., 1947).—For I, see Abstr. 2686 (1946). Chromatons of single solutes, in particular the case of sigmoid erms, are treated theoretically and measured erimentally. The form of the chromatograms lting from the different isotherms and the movement heir characteristic points are shown and calculated. orption and exchange isotherms can be calculated chromatographic elution curves. Comparison of sotherm, determined in this way, with directly deter- ed equilibrium values shows a good agreement, and chromatographic method gives a much larger number oints for less experimental work. A.

.183.5 1350

heory of chromatography. III. Experimental separa- of two solutes and comparison with theory. COATES, ., AND GLUECKAUF, E. *J. Chem. Soc.*, 1308–14 ., 1947).—The results obtained in I for chromatos of two solutes are summarized, giving the features movements of the important parts of binary chroograms at various stages of the development. The lts are given both for the general case and for the cial case of the Langmuir isotherm. The agreement hese calculations with quantitative elution experiments hown for a chromatographic separation of Cu^{++} Mn^{++} on Zeo-karb H.I., the exchange of which ows approximately an isotherm of the Langmuir . A.

.183.5 1351

heory of chromatography. IV. The influence of mplete equilibrium on the front boundary of chromatoms and on the effectiveness of separation. GLUECKAUF, AND COATES, J. I. *J. Chem. Soc.*, 1315–21 (*Oct.*, 1947).—It is shown that in the chromatographic column, under the usual working conditions, complete local equilibrium is not obtained. A theory is developed for the effect of incomplete equilibrium on chromatographic boundaries, and the form of observed boundaries agrees with those calculated. On decrease of grain size and flow velocity, equilibrium becomes more complete, and then some chromatographic separations can be effected with ease which are impossible by the usual methods, e.g. the separation of Ni and Co ions on alumina. A.

541.183.5 1352

Theory of chromatography. V. Separation of two solutes following a Freundlich isotherm. GLUECKAUF, E. *J. Chem. Soc.*, 1321–9 (*Oct.*, 1947).—An attempt is made to predict the behaviour during chromatographic separation of solutes following individually a Freundlich isotherm $ac = q^n$. A method is shown for the graphical solution of the fundamental chromatographic equation $dq_1/dc_1 = dq_2/dc_2$, which makes it possible to calculate the distribution of solutes in binary chromatograms for any type of isotherm. It is shown that in the case of Freundlich isotherms, two essentially different types of chromatogram must be expected. In order to obtain complete separability into two adjoining bands the conditions must be fulfilled that the molar phase ratio at the point of separation of the bands

$$\left[\frac{q_2}{c_2}\cdot\frac{c_1}{q_1}\right]_{q_1=0} > n_2$$

If the leading solute has the lower value of n, i.e. if $n_1 < n_2$, this can always be achieved by working at low enough concentrations. If this condition is not fulfilled, solute 2 cannot be obtained pure, but can only be enriched. Pure solute 1 can always be obtained, though in the latter case not quantitatively. Chromatographic separation is the easier the smaller the ratio n_1/n_2 of the Freundlich exponent. A.

ATOMIC THEORY 541.2

541.24 : 541.64 : 538.614 : 538.224 1353

Magnetic studies on polymerisation. I. Magnetic optical rotatory powers and diamagnetic susceptibilities of certain polymethyl methacrylates. BEDWELL, M. E. *J. Chem. Soc.*, 1350–3 (*Oct.*, 1947).—The magneto-optic rotatory powers and diamagnetic susceptibilities of methyl methacrylate and the polymethyl methacrylates have been measured. The results may be employed to calculate the average molecular weights of the polymers, fair agreement being obtained with values determined by a viscosity method (Schulz and Blaschke). A.

CHEMICAL STRUCTURE 541.4/.6

541.57 1354

The C–H bond energy in toluene and xylenes. SZWARC, M. *J. Chem. Phys.*, **16**, 128–36 (*Feb.*, 1948).—The pyrolysis of toluene and the xylenes was investigated by a new technique, which made it possible to study these reactions for degree of decomposition ranging from 0·01 up to a few %. It was shown that these reactions are homogeneous, unimolecular reactions. It was found that the weakest bond in these molecules is the C–H bond in the methyl group. The energy of that C–H bond was found to be 77·5 kcal for toluene and *m*-xylene, 75 kcal for *p*-xylene and 74 kcal for *o*-xylene. These data indicate that the resonance energy of the benzyl radical is 24·5 kcal and that the hyper-conjugation in *p*-xylene

decreases the C–H bond energy in the methyl group of this molecule by 2·5–3 kcal. A.

541.57 : 539.132 *see Abstr.* 1297

541.6 1355

On the structure of cellulose acetate molecules in acetone solution. SINGER, S. J., AND MARK, H. *J. Appl. Phys.*, **19**, 97–101 (*Jan.*, 1948).—Data obtained from sedimentation velocity and viscosity measurements on a series of cellulose acetate fractions in acetone are interpreted in terms of two models, the impenetrable ellipsoid of rotation and the uniform density random coil. Neither is a satisfactory model. Probably the best hydrodynamical model for these and other extended but not perfectly rigid molecules in solution is a penetrable ellipsoid of rotation. A.

541.63 : 548.736.33 *see Abstr.* 1365

541.64 : 538.614 : 538.224 : 541.24 *see Abstr.* 1353

CHEMICAL APPARATUS 542.1/.7

542.231 1356

A one-point or 'full' level indicator for use with low boiling-point liquids. JONES, G. O., AND SWENSON, C. A. *J. Sci. Instrum. Phys. Ind.*, **25**, 72–3 (*March*, 1948).—The indicator described was designed to give an indication when a liquid H container was full. Vapour abo the liquid is continuously drawn off through capilla tubes with openings at different heights, and across whi a differential manometer is connected; when the end the lower capillary becomes immersed, the manometer actuated. The only external connections to the contain are the two capillary tubes.

CHEMICAL ANALYSIS 543/545

545.82 : 535.33 13

Summarized proceedings of Conference on Industri Spectroscopy. Glasgow, June 1947. *J. Sci. Instru Phys. Ind.*, **25**, 95–102 (*March*, 1948).—The followi papers were read: The spectrographic analysis of no conducting powders in the carbon arc, Mitchell, R. L and Scott, R. O.; The photographic aspect of spectr scopy, Selwyn, E. W. H.; The use of the electron mul plier in emission spectroscopy, Mitchell, G. P., a Popper, P.

545.82 : 535.33.03 *see Abstr.* 1195

545.82 : 535.33.072 *see Abstr.* 1198

545.82 : 535.375.5 *see Abstr.* 1212–13

545.824 : 539.26 : 548.73 *see Abstr.* 1361

CRYSTALLOGRAPHY 548

548.0 : 535.32 1358

Studies of the optical properties of some organic crystals. DATTA, M. N. *Indian J. Phys.*, **21**, 302–6 (*Dec.*, 1947).—The directions of the optical principal directions of the monoclinic crystals—anthraquinone and naphthalene tetrachloride—have been determined for three different wavelengths in the green, yellow and red regions of the spectrum. The principal refractive indices for these wavelengths have been determined for the crystals of anthraquinone, *m*-dinitrobenzene, phloroglucine dihydrate and naphthalene tetrachloride. A.

548.0 : 537.311.32 *see Abstr.* 1241

548.3 : 548.736.442 *see Abstr.* 1366

548.71 : 536.63 : 539.11 *see Abstr.* 1285

548.73 1359

Extra reflections in Laue photographs of benzil. SEN, R. K. *Indian J. Phys.*, **21**, 285–94 (*Dec.*, 1947).—The results of accurate measurements of the positions of extra spots and streaks are reported. It is shown that the reciprocal lattice points of benzil have planar extensions parallel to a^*c^* planes with sharp extension along a^* axes. The shape of the scattering domains around the reciprocal lattice points depends on the direction of the incident beam. The nature of the derangement waves giving rise to the extra reflections are discussed. A.

548.73 : 532.782 1360

The lattice spacings of solid solutions of different elements in aluminium. AXON, H. J., AND HUME-ROTHERY, W. *Proc. Roy. Soc. A*, **193**, 1–24 (*April* 22, 1948).—Measurements have been made of the lattice spacings of solid solutions of Li, Mg, Si, Cu, Zn, Ge, and Ag in Al. The lattice of Al is expanded by the solution of Mg or Ge, and contracted by the solution of Li, Si, Cu or Zn. No change in lattice spacing can be detected when Ag is dissolved in Al, although microscopic examination shows that a solid solution is formed, and this is confirmed by the absence of any diffractic lines other than those of the solid solution in Al. If t lattice spacing/composition curve for dilute solutions extrapolated to 100% of solute, the resulting latti spacing refers to a hypothetical face-centred cub modification of the solute, and the corresponding close distance of approach of the atoms is called the appare atomic diameter (a.a.d.) of the solute when in solutio in Al. Previous work enables the corresponding a.a values to be deduced for the above solute elements wh dissolved in univalent Cu, Ag or Au, and in divalent M The differences between the a.a.d. values of a giv element when dissolved in various solvents are discusse and it is suggested that they are controlled by the interpl of four factors: (*a*) the relative volume per valen electron in crystals of the solvent and solute; (*b*) t relative radii of the ions of solvent and solute; (*c*) Brillou zone effects; and (*d*) the difference between solvent a solute in the electrochemical series. If this line approach adopted be correct, it follows that it is only exceptional circumstances that the so-called Vegard law will apply to metallic solid solutions.

548.73 : 539.26 : 545.824 13

Summarized proceedings of Conference on X-r Analysis—London 1947. *J. Sci. Instrum. Phys. Ind.*, 2 90–5 (*March*, 1948).—The subjects discussed include Training of X-ray crystallographers; Technique of X-r powder photography; New methods and results of X-r analysis; New industrial techniques and results.

548.734.5 13

A rapid X-ray method for the determination of t orientation of single crystals or large-grained polycrystalli aggregates. DE BARR, A. E. *J. Sci. Instrum. Phys. In* **25**, 102–4 (*March*, 1948).—A type of goniometer described which enables a crystal to be set in a giv orientation. The method makes use of strong, hig Bragg angle, reflections which can be received on fluorescent screen. The orientation of any given face

crystal can readily be calculated from the readings wo angle scales on the instrument, and can be plotted stereographic projection. The calculations necessary plotting the crystal face are given. A.

734.52 : 518.3 1363

n alignment chart giving the polarization correction of -inclination Weissenberg photographic intensities. D, W. L. *J. Appl. Phys.*, **19**, 82–3 (*Jan.*, 1948).— omograph gives the polarization factors in terms of co-ordinates μ and Υ. The remaining correction, Lorentz factor, merely involves division by $\cos^2\mu$ Υ. A.

734.82 1364

elf-printing X-ray diffraction interplanar scale. DE-TTEVILLE, A. P., JR., AND LEVIN, S. B. *Rev. Sci. rum.*, **19**, 120–1 (*Feb.*, 1948).

736.33 : 541.63 1365

he crystal structure of anhydrous cupric chloride, and stereochemistry of the cupric atom. WELLS, A. F. *Chem. Soc.*, 1670–5 (*Dec.*, 1947).—Anhydrous $CuCl_2$ onoclinic: $a = 6{\cdot}85, b = 3{\cdot}30, c = 6{\cdot}70$ Å, $\beta = 121°$; ce-group $C2/m$, with Cu at 000, $\frac{1}{2}\frac{1}{2}0$ and 4 Cl at $x0z$, , $x \simeq \frac{1}{4}$, $z \simeq \frac{1}{4}$. The structure contains infinite chain ecules formed by planar $CuCl_4$ groups sharing osite edges, as in $PdCl_2$. The packing of these chains ifferent from that found in $PdCl_2$, apparently in order give Cu^{II} two next nearest neighbours at ~ 3 Å com-ing a distorted octahedral co-ordination group. The eochemistry of the cupric atom is discussed. A.

736.442 : 548.3 1366

he crystal structure of $CsCuCl_3$ and the crystal mistry of complex halides ABX_3. WELLS, A. F. *Chem. Soc.*, 1662–70 (*Dec.*, 1947).—The crystal ucture of $CsCuCl_3$ is determined. The crystals are agonal, $a = 7{\cdot}20$, $c = 18{\cdot}00$ Å; space-group $C6_12$, with 6 molecules of $CsCuCl_3$ per cell. There are infinite chain ions of composition $(CuCl_3)_n^{n-}$ formed by planar $CuCl_4$ groups joined up by sharing two adjacent Cl atoms, these ions being in the form of spirals around the 6-fold screw axes. They are held together laterally by the Cs ions. The crystal chemistry of complex halides ABX_3 is discussed. A.

548.74 1367

The interpretation and application of electron-diffraction 'Kikuchi-line' patterns. I. The determination of the crystal unit cell, its orientation and the crystal symmetry. WILMAN, H. *Proc. Phys. Soc., Lond.*, **60**, 341–60 (*April*, 1948).—The interpretation of electron-diffraction Kikuchi-line patterns from single crystals is developed as a powerful independent and general means of determining the crystal lattice type, dimensions and orientation and the Laue symmetry of the atomic arrangement. This aim is realized by a construction of the reciprocal lattice by methods which are described and illustrated. The satisfactory accuracy of the method is due to the relatively precise definitions for the location of the Bragg reflection positions, derived and stated here for the first time, which enable the method to be used even when the crystal lattice constants are large so that the bands are narrow and diffuse-edged, as with rhombic sulphur. The patterns shown also illustrate features of the line intensities, especially the reduction in intensity when the bands pass near the undeflected-beam spot. A.

548.75 : 539.13 : 535.51–15 : 535.343–15 *see Abstr.* 1202

MINERALOGY 549

549.514.51 : 537.228.1 1368

Domestic sources of piezoelectric quartz. WAESCHE, H. H. *Amer. J. Sci.*, **246**, 182–5 (*March*, 1948).

GEOPHYSICS 55

.383 1369

Blackett's fundamental theory of the earth's magnetic d. CHAPMAN, S.; RUNCORN, S. K. *Nature, Lond.*, **1**, 52 (*Jan.* 10, 1948).—An inexactitude in the formula ed by Hales and Gough [Abstr. 1123 (1948)] is pointed t, and a more general formula is given. The change in value of variation is less than the uncertainty of les' and Gough's experiments.

ATMOSPHERE . METEOROLOGY 551.5

551.508.94 : 551.594.11 1370

A radiosonde method for atmospheric potential gradient easurements. BELIN, R. E. *Proc. Phys. Soc., Lond.*, , 381–7 (*April*, 1948).—The radiosonde transmits the lue of the current flowing in the wire connecting two arp points arranged in opposite senses in a vertical line me 60 ft apart. The minimum potential gradient pable of beginning point discharge was determined perimentally as 3 V/cm at N.T.P. The results of a pical sounding of a cumulo-nimbus cloud are given, d the range of application discussed.

551.510.4 : 551.521.63 1371

Measurement of ozone over the Organ Mountains, New exico. STAIR, R. *J. Res. Nat. Bur. Stand., Wash.*, **40**, 9–19 (*Jan.*, 1948).—Gives data on the total amount of O_3 as determined from ultraviolet measurements by a phototube and filter method. The measurements indicate ozone in the stratosphere in amount about equivalent to a 0·21-cm layer at N.T.P., which is in good agreement with determinations by others. The total O_3 value and the solar-energy curve in the region of short u.v. wavelengths outside the earth's atmosphere check closely with previous work with the same instruments. A.

551.510.535 1372

Abnormalities in the *F*-region of the ionosphere at Calcutta. BARAL, S. S., GHOSH, S. N., AND DEBRAY, M. *Nature, Lond.*, **161**, 24 (*Jan.* 3, 1948).—During January, 1947, a month of maximum sunspot activity, the electron density as observed at Calcutta and Madras maintained its high noon value until late in the evening, instead of falling during the afternoon, as was observed at Delhi and at Slough. The difference in magnetic dip values at Calcutta and Delhi is pointed out.

551.521.63 : 551.510.4 *see Abstr.* 1371

551.54 : 532.528 *see Abstr.* 1163

551.574 : 536.42 *see Abstr.* 1229

551.594.11 : 551.508.94 *see Abstr.* 1370

BIOLOGY 57/59

578.088.5 : 539.166.08 *see Abstr.* 1313

591.185 : 530.162 1373

Minimum perceptible energy and Brownian motion in sensory processes. DE VRIES, H. *Nature, Lond.*, **161**, 63 (*Jan.* 10, 1948).—Tentative quantitative estimates of the minimum perceptible energy are made, on the assumption that it must be substantially above the spontaneous excitation of the sensory equipment by the thermal fluctuations or Brownian motion of the equipment itself. Vision, excitation of a nerve and hearing are considered and the values 53 kT, 25 kT and 0·3 kT are obtained. The first two are reasonable values, the last so far below experimental values as to arouse special interest.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.843.612 = 4 1374

Sensitivity of precision polarimeter and sensitivity of the eye to brightness difference. LÉVY, A. *Rev. Opt.* (*Théor. Instrum.*) **26**, 489–94 (*Dec.*, 1947) *In French.*—The sensitivity of a polarimeter with a Lippich analyser can be used to study the sensitivity of the eye to small differences of brightness. The results obtained are applied to test the various theories put forward to account for the variation of this threshold discrimination with the brightness of the field of view. J. W. T. W.

612.843.615 = 4 1375

Contribution to the study of the inhibitory component in glare. IVANOFF, A. *Rev. Opt.* (*Théor. Instrum.*) **26**, 479–88 (*Dec.*, 1947) *In French.*—A study of glare by the binocular method [Abstr. 2121 (1939)] is made for various combinations of colours of (*a*) the glaring light and (*b*) the field of view. Yellow is found both to give the least glaring effect and to provide a field in which glaring effects are least for any given intensity. J. W. T. W.

612.85 : 534.75 *see Abstr.* 1187–8

615.849 1376

Dosage calculations in radium therapy: an exhibit. QUIMBY, E. H. *Amer. J. Roentgenol. Radium Ther.*, **51**, 622–7 (*May*, 1947).—Tables of data are reproduced. These illustrate point and tubular Ra sources, distribution of radiation intensity, types of applicators and the resulting intensity distributions of such applicators. B. J. L.

615.849 137

A radium dosage calculator. SPENCER, E. W., AND JOHNS, H. E. *Amer. J. Roentgenol. Radium Ther.*, 57 711–22 (*June*, 1947).—Description of a slide-rule calculator and its use in connection with linear source, plane surface and cylindrical surface applicators. Its mathematical basis and construction are given in detail. B. J. L.

615.849 : 537.531 137

Efficient deep tumor irradiation with roentgen rays of several million volts. TRUMP, J. G., MOSTER, C. R., AND CLOUD, R. W. *Amer. J. Roentgenol. Radium Ther.*, 57 703–10 (*June*, 1947).—The principles of multiple field deep X-ray treatment are briefly explained. Developments in high voltage excitation of X-ray tubes, such as the van de Graaff generator used by the authors, increase the efficiency. This apparatus has been operated at from 1–4 MV for therapeutic purposes. The spectra and spatial distributions of the radiation are shown for ½–3 MV. Treatment details of the subcutaneous effects, depth dose and scattering, and the related isodose curves for 2 MV are given. Photographs obtained by the ionizing effects of the rays for single, 3-field and continuous rotation of the tube are illustrated. It is claimed that with such high voltages the patient absorbs a less undesired total dose, at situations not requiring irradiation. Above these voltages, however, owing to non-uniformity of the beam intensity and the large exit dose i.e. unabsorbed radiation passing completely through the patient, disadvantages result. B. J. L.

616.12–073.96 137

Electrokymograph for recording heart motion, improved type. HENNY, G. C., BOONE, B. R., AND CHAMBERLAIN, W. E. *Amer. J. Roentgenol. Radium Ther.*, **57**, 409–1 (*April*, 1947).—An instrument is described in detail in which a selected part of the cardiac X-ray shadow upon a fluorescent screen faces a photosensitive photo-tube which is activated by the illumination. The resulting photo-electric currents are recorded by a string galvanometer. A device to record the carotid pulse simultaneously is also described. Typical recordings are illustrated. B. J. L.

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Characteristics of some non-screen films used in industrial radiology. DURANT, R. L. *J. Sci. Instrum. Phys. Ind.*, **25**, 105–10 (*March*, 1948).—An investigation has been made of the characteristics of selected X-ray films suitable for use with metal intensifying screens, with particular reference to their variation with time of development within the range of 2–20 min. The results show that a much wider range of film speed and contrast can be obtained. In extreme cases, speed ratios of 400 : 1, and contrast ratios of 5 : 1 are obtainable by modification of the time of development alone. Applications of this technique to practical radiography are considered both for obtaining maximum contrast and also for matching the density range of the film to the range of thickness in the specimen. The variation of development technique as an alternative to variation of tube voltage is discussed; the former is more useful for voltages > 200 kV, the latter at lower voltages. A

771.534.54 : 628.97 138

Tone reproduction accuracy for technical records. HOPKINSON, R. G. *Photogr. J.*, **87B**, 136–41 (*Nov.–Dec.*, 1947).—The essential conditions for obtaining a photographic record of a lighting installation, the record being of "engineering accuracy," are analysed. Detailed consideration is given to the requirements of contrast for correct reproduction and a simplified expression to give the correct value of the brightness of the reproduction is stated. A

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